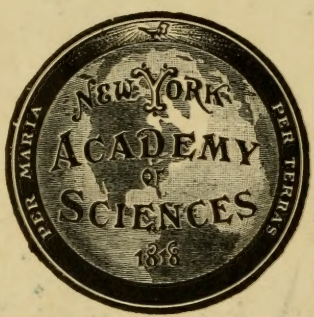

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TRANSACTIONS

OF

THE CANADIAN INSTITUTE.

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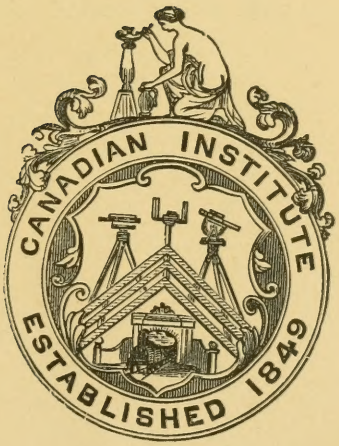

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TRANSACTIONS

OF

THE CANADIAN INSTITUTE,

SESSION 1890-91.

FIRST MEETING.

First Meeting, 1st November, 1890, the President in the chair.

Donations of books and pamphlets since last meeting, 279, including 151 volumes from Mrs. Seidler, and 61 volumes from Hugh Wilson, F.G.S., who also presented 45 specimens of Canadian woods.

Exchanges since last meeting, 2,042.

The following were elected members:—A. H. F. Lefroy, M.A., Dr. R. Orr, Widmer Hawke, Fred. A. T. Dunbar, Dr. Thomas Millman, J. J. Murphy, C. G. Cremer, and Hugh Wilson, F.G.S.

The Council reported the election of Frank Tweed as an associate.

The following communication from A. H. F. Lefroy, M.A., was read by Dr. Kennedy:—

"GENERAL SIR JOHN HENRY LEFROY, K.C.M.G., C.B., F.R.S.

"I desire to comply with the kind request of the Canadian Institute as contained in their resolution of April last, and furnish a short biographical notice of my father, General Lefroy, who died on April 11th of this year. He was a son of the Reverend John Henry George Lefroy, Rector of Ashe, in the County of Hampshire, in England, and was born at Crondall, in that County, in 1817. In his 17th year he obtained his commission in the Royal Artillery, one of the two scientific regiments in the service, and throughout his life his energies were largely occupied in scientific work, and especially in the scientific work of his profession. Thus it will be seen that he did not enjoy the advantages, which he esteemed so highly, of a University training.

"In 1839 he was sent to the Island of St. Helena as director of the Magnetical Observatory there. In 1842 he was chosen by the Royal Society to undertake the work of a Magnetic Survey of the British

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possessions in North America, and during the years 1843 and 1844 he made a series of magnetic observations extending as far as Fort Good Hope on the Mackenzie River, the results of which were recently revised and published by him in a work entitled, "Diary of a Magnetic Survey of a Portion of the Dominion of Canada, Chiefly in the North-Western Territories:" (Longmans, Green & Co.) Mount Lefroy, in the proximity of Kicking Horse Pass, in the Rocky Mountains, was named after him, as was also the village of Lefroy, in the County of Simcoe, in this Province, thus preserving the memory of his name in the two parts of the Dominion in which his work and associations chiefly lay.

"In 1844 he was placed in permanent charge of the Magnetic Observatory in Toronto, and in 1852 was President of the Canadian Institute, having been Vice-President in the previous year, the year of its origin. In the first volume of the proceedings of the Institute are to be found papers by him on "Theometric Registers" and on "The Probable Number of the Native Indian Populations of British America." Returning to England in 1853, he was appointed secretary to the Royal Artillery Institution at Woolwich, which he had himself been mainly instrumental in founding in 1838. Passing by minor appointments, in 1857 he was gazetted Inspector-General of Army Schools, and in 1869 Director-General of Ordnance. In 1871 he was appointed Governor of the Bermudas, and during his term of office was made a Companion of the Bath, and Knight Commander of the Order of St. Michael and St. George. On his return home he published, in two large volumes, the early Chronicles of the Bermudas (Longmans, Green & Co); and one of his latest literary labours was to edit for the Hakluyt Society, from a manuscript in the Sloan Collection of the British Museum, "The Historye of the Bermudaes or Summer Islands," the authorship of which is attributed to Captain John Smith, the historian of Virginia, and covers a period from 1609 to 1622. In 1880 he was for a short period Governor of Tasmania. In 1881 he attained the rank of Colonel Commandant in the Royal Artillery, and in 1882 retired from the service with the rank of General

"My father belonged to a great number of the learned societies in London, and took an active interest in their proceedings. He was a fellow of the Royal Society, the Geographical Society, the Society of Antiquaries, the Royal Archæological Institute and the Hakluyt Society. He was also a member of the Council of the Royal Society from 1878 to 1880, and of the Geographical Society for one year. He was a life member of the British Association for the Advancement of Science, and in 1884 presided over the Geographical Society of that Association when it met in Montreal. He served on the Committee

of the Palestine Exploration Fund. He was a member of the Athenæum Club, which is the great literary club of London, and also of Nobody's Club. I should also state that in 1883 McGill University conferred upon him the degree of LL.D.

"In 1848 he married a daughter of the late Sir John Beverley Robinson, then Chief Justice of Upper Canada, who died in 1859. He subsequently married a daughter of Lieut.-Colonel Thomas Dundas, of Carron Hall, Stirlingshire, Scotland, who survives him.

"My father was throughout his life a frequent contributor to the proceedings of the various learned societies to which he belonged. He also took a keen interest in the political and public questions of the day, in literature, and in history. For matters of family history, of genealogy, and of heraldry he had a marked taste, and collected with much labour, and in 1868 privately published, the records of our own family. A devoted son of the Church of England, he made a life-long study of her theology, and was especially an admirer and student of Hooker's great work on Ecclesiastical Polity.

"It is, however, for others, and not for me, to speak of my father's deep religious convictions, and consistent Christian life; of the breadth of his mind and the unflagging zeal with which he flung himself into all his work; of his well-directed energy, of the activity of his mind, and his widely-extended interests; of the kindliness of his heart, and his charitable efforts on behalf of the Patriotic Fund and numerous other benevolent institutions, and of his high standard of honour and of principle. It would, I am sure, be a gratification to him to know that some record of his life, however imperfect, was preserved in the pages of the Journal of the Canadian Institute, in the welfare of which he felt so much interest, as indeed he did in everything connected with Canada."

Mr. David Boyle, Ph.B., read a paper on "The Canadian Institute of the Future." He referred to the approaching jubilee of the Institute as a fitting opportunity to look forward as well as backward. Reference was made to the work that has been performed, as evidenced by the many volumes of proceedings and transactions issued, and special notice was taken of the fact that Mr. Sandford Fleming first proposed the standard time system now rapidly becoming adopted. Mention was made of the many distinguished men who have been connected with the Society since its foundation, but, notwithstanding all this, it was deplored that the Institute did not accomplish all the good it was capable of. The condition and management of the reading-room, library, and museum were criticised, and the situation of the building and night of meeting (Saturday) were mentioned as hindrances to success. Want of funds was

referred to as crippling every effort to progress, and it was suggested that the annual fees be raised from $4 to $10, or even more. It was held that "after an existence of forty years the Institute should occupy a very much higher and more honourable position in Ontario and Canada than it does. Its *dicta* on scientific and historical matters should be respected, its library of works upon such subjects ought to be the best in the Dominion, its opinions should be quoted, and its wishes consulted. Its publications should be sent among the people by thousands, and not by a few paltry hundreds, and to be one of its members ought to be regarded as highly meritorious." A supposititious account of the Institute twenty years hence brought out by comparison many existing defects. The following were offered as suggestions for the future :—Summer and winter meetings elsewhere than in Toronto ; special meetings in the rooms during the regular session, with invitations to the public ; increased activity on the part of individual members ; increased annual payments and an entrance fee; removal to larger and more conveniently situated premises, and a change in the night of meeting ; failing increase of revenue and ability to secure better accommodation, to hand the library and museum over to the City Public Library, or the books alone to it, and the museum to the University. Reference was made to the attempts of some to secure Upper Canada College, and a suggestion to organize the Institute on a basis analogous to that of the Washington Smithsonian was discussed The paper closed with a suggestion that a committee be appointed to take the whole of this subject into consideration and " prepare a report whereby it may be deemed possible to place the Canadian Institute on such a footing financially, and influentially, as may tend to its becoming all it ought to be, and all its best friends fervently desire it should be, namely, the largest, most useful, and best accredited scientific association in Canada, and not inferior to the best in any other country.

Mr. O. A. Howland suggested the propriety of making a valid claim to the Upper Canada College grounds. He thought that a united effort should be made by the Institute and other societies for that purpose. The Institute would start with a certain amount of capital, and would be entitled to take the lead. The Upper Canada College grounds would be the very best site for the purpose. It would be the most suitable for the musical societies, for the Art Association, and for museum purposes, and would be one of the most prominent objects presented to the visitors of Toronto. He suggested that the members who had formerly been appointed on the committee to act with other bodies should be re-appointed.

Mr. William Houston was in favour of changing the night of meeting from Saturday to some other night of the week. It would be an advan-

tage to have newspaper men attend the weekly meetings, but reporters cannot attend on Saturday night.

Mr. Arthur Harvey would rather look to the labours of the few to form the strength of the Institute than to the accession of the many. He did not think that its prosperity was to be advanced by courting popularity. He referred to the large amount of valuable work that had already been done. He said that Mr. Boyle had not alluded to the fact that it was on the action of the Institute that the Provincial Government had made the grant for archæological purposes. The Canadian Institute of the future should have nothing to do with anything but the consideration and discussion of the subjects which were brought before it. It was on these lines that other important and valuable societies had worked. He had viewed with a good deal of interest the movement that Mr. Howland and his friends had inaugurated for obtaining the Upper Canada College grounds in conjunction with the other societies mentioned.

Mr. Pearce, in reference to what Mr. Boyle had said about handing over the museum to Toronto University, could not agree to the surrender of that portion of it that belonged to the Biological Section. As to the matter of obtaining funds, he recollected calling on 30 or 40 out of a list of 82 merchants, and did not succeed in getting more than five dollars. The efforts for getting up a conversazione last year had failed through the inability to raise the requisite funds. He was in favour of a location for the Institute further up town. Somewhere nearer the University would be much more convenient. He recommended that enquiries should be made about the lot on McCaul street that had been referred to.

Mr. Dewar was not in favor of removing to another locality. He thought that one near the University would not be so convenient for strangers in the city. He would like to see the professors and other men of eminence in scientific pursuits attend the meetings and take a more active part in the proceedings.

Mr. Squair: If the Institute was located farther up in the city, and nearer to where he lived, he would attend oftener, but it would not be wise to move for the sake of benefiting some when it may inconvenience others. He was altogether opposed to raising the amount of the annual subscription to ten dollars; he thought four dollars was quite enough. As to the want of prosperity, it would be necessary to look deeper for the causes. This was not a scientific country, and a good deal of the work of the Institute, though valuable in itself, did not interest any large body of the public. He referred to the amount of very valuable work that had been done by the active members. As to the Philological Sec-

tion, he was amused at the enthusiasm displayed by some of those who got it up, but who soon became tired of it.

Mr. Pearce spoke of the prosperity of the Biological Section. Not only was there a large amount of work done by the section, but also by the several sub-sections into which it had been divided. If all the other sections of the Institute were as strong as the Biological Section, it would be in a very prosperous condition.

Mr. Browning said the division into sections had worked well in the case of the Biological Section, but not in regard to the other sections. He would like to see some effort made to obtain the Upper Canada College grounds. He supposed, however, that these grounds would go to the University, and was afraid the Institute would not get any part of them. The next question was the sale of the present building and the erection of one in some other locality. He would like to see a building put up that would yield a revenue. They would require one costing about $75,000. He thought that something could be done in the way of raising funds outside the membership of the Institute.

The following were named a committee to take into consideration the matters relating to the Institute referred to in Mr. Boyle's paper:—The President, and Messrs. Boyle, Pearce, Howland, Houston and Harvey.

SECOND MEETING.

Second Meeting, 8th March, 1890, Mr. G. G. Pursey, in the chair.

Donations and exchanges, 57.

A circular was read from the Committee of Organization of the International Congress of the Geographical Sciences stating that the Congress would be held at Berne, in August, 1891, on the occasion of the festival commemorative of the seventh centenary of the founding of the City of Berne, explaining the objects of the Congress and requesting the co-operation of the Canadian Institute.

Mr. Boyle read a memorial to the Hon. the Attorney-General respecting the publication of certain historical documents, and moved the following resolution, which was seconded by Mr. Harvey, and carried:—

"That the Council of the Institute be empowered and requested to present to the Government of Ontario the facts now expressed by them, also to enquire if the correspondence of Governor Simcoe and the military

archives of the forces in Canada at and about the period of the establishment of the separate Provincial Government for Upper Canada, recently acquired by the archivist at Ottawa, have been examined by them with a view to the publication thereof, either in full or in abstract form, as is now being done in the case of similar documents by the Province of Quebec."

Moved by Mr. Houston, seconded by Mr. Douglass, and carried :—

"That the members of this Institute learn with pleasure that the Executive Committee of the National Teachers' Association of the United States have decided to hold their next annual meeting in Toronto, in July, 1891, and they earnestly urge upon all who are in a position to do so, to aid in making the Convention as successful as possible."

Moved by Mr. Cox, seconded by Mr. Boyle, and carried :—

"That the members of the Canadian Institute hereby acknowledge the invaluable services rendered to the Institute by Mr. A. F. Chamberlain, M.A., for many years past, and whilst regretting the loss of so useful and promising a fellow-member, heartily congratulate him on his advancement to a larger, and they would hope a more congenial, sphere of labor."

Moved by Mr. Boyle, seconded by Mr. Clark, and carried :—

"That the members of the Institute have heard with great regret of the death of Mr. Hugh Wilson, who recently became a life member, and who made valuable donations of books and specimens to the Institute, and instruct the Secretary to convey their condolence to his relatives."

The following were elected members :—Arthur Laughlin, J. S. Laughlin, and J. M. McEvoy, B.A.

Mr. W. A. Douglass, B.A., read a paper on "The Two Values."

The paper began by showing that in every community the assessor or census enumerator finds two distinct things : first, a quantity of houses, goods, etc., that labour places there, and the land that labour did not place there. He thereupon finds two values—1st, that of improvement ; 2nd, that of land. With every increase of population these two values increase. The differences between the characteristics of these two values were examined at some length, illustrated by diagrams, and may be thus summarized :—The aggregate value of the commodities increases as commodities become more abundant, while the value of land increases as it becomes relatively more scarce. The one value indicates abundance, the other scarcity. Commodities come only with toil ; land value is not the result of toil. Commodities soon disappear, consumed or worn out ;

hence their value is transient. Land value never disappears, but remains as long as population lasts. Hence the value of commodities demands the continuous exertion of toil every year to maintain it, while land value remains without any toil. The use of machinery, by economizing labour, can reduce the value of certain commodities ; but no machinery has ever been devised, or will be devised, to extinguish land values. Increased population also reduces the value of certain commodities, but it has the opposite effect with land values. Increased population leads to increased production, and consequent intensified competition between sellers ; but on the other hand it causes more demand for land, and hence lessened competition between sellers. A large portion of commodities, moreover, are such that they must be sold in season—bonnets and spring bonnets—hence holding for a rise is impossible; but land never rots, wears out, or goes out of fashion. These characteristics are so distinct that what is declared affirmatively of one must be declared negatively of the other; whatever character we find in one we find the opposite in the other. They are as diffierent as plus and minus, or asset and liability. And yet in our legislation, whether for assessment, assigning the rights of property, or distributing wealth, we treat these two opposite things as though they were one and the same—a fatal mistake, leading to monstrous divergencies in society. By this mistake we allow one part of society to secure large service from the rest of society, simply because land becomes more scarce, and thus every increase of society makes a widening of the gulf in society, carrying the landowner to greater fortune, and the industrious classes togreater misfortune. All these opposite characteristics between the two values show that the one only, namely, that of commodities, should be held as property by individuals, the other should belong to the State.

Mr. Harvey had listened to the paper with mingled sensations of pleasure and of pain. Of pleasure, because the author, like others who had adopted these new social doctrines, spoke with an air of conviction, as if he believed what he was saying, also with that charming air of resignation and pity which pleasantly distinguished the elect, the *illuminati*, of many harmless kinds, and with a grace of diction which might well awake envy in less gifted men. Of pain, akin to that which a cat might feel when its owner, in a fit of abstraction, was stroking its fur the wrong way. Every proposition laid down seemed thoroughly antagonistic to what he (Mr. Harvey) had been taught in his youth to believe, and every argument made use of seemed to be based on fallacies. He felt that the author of the paper was dealing out delusive sophistries, and propounding theories, every one of which needed but the touch of experience to burst them. Let him give one instance. He was the

owner of a piece of land in the enterprising, historical, and whilom ambitious city or town of Dundas. Twenty years ago the land was "encumbered," should he say, with a house ; the house was burned, and the land had been held as a vacant lot for many years. Now, according to Mr. Douglass' theory, he ought to have been a millionaire. Surely by this time, according to Mr. Douglass' calculation, the land ought to have doubled in value, and quadrupled that; but alas! for the fruit of a vanished hope! and alas! for the trust in the "Two Values" test! when he had proposed to a friend in the locality to give him cats, dogs, anything, and take the blessed lot, that friend had smiled (as Mr. Douglass did) a pleasing smile, and remarked on his (Mr. Harvey's) plaintive way of putting it. Let him now take Mr. Douglass' arguments in hand on the port tack, after raking them on the starboard, and ask in which of his two categories, commodity or land, he would put a painting of Raffaelle or Annibale Caracci. In quantity limited, area fixed, produced with toil, preserved only by thought and care, enduring, and cherished by many generations, ever increasing in money value, and priceless in these other values which men of Mr. Douglass's school scarcely seem to admit—humanizing, refining, elevating influences,—such works or things surely traverse in lightning-like zigzags, and altogether confuse and confound the straight-laced lines of Mr. Douglass' parallel columns of fallacious attributes. The truth was that all commodities possessed different economic attributes. Food, buildings, money, metals, land, all differed ; but to treat land otherwise than as a marketable commodity surely misled the deluded followers of this new school of unpractical dilettanti, *per ambages*, into a morass. He would have proceeded to ask how Mr. Douglass' theory worked with land in Arabia, or (if he said he meant good land and not sandy wastes) how it applied to the land of Babylonia, with its rich and varied yield and its many paradises, which he had doubtless read about in his Xenophon, but now seemed to have forgotten. Dissatisfied theorists reasoned on premises which might seem correct when they were tested by instances occurring in happy, peaceful and growing districts of country ; but when they were applied to towns which were retrograding, or countries scourged by wars or bad government, they were plainly seen to be hideously false—the clay underpinning of their hollow, brazen simulacrum gave way. It had lately happened to him (Mr. Harvey) to cross the ocean on the "Servia" with Mr. Henry George for a fellow-passenger. On leaving the dinner table one day, during a swell time, Mr. George, coming between the rows of chairs, mostly empty, careened against one, rebounded from another, and came violently to moorings beside the speaker. "Mr. George," he had remarked, "you get on well in smooth weather, but this gale upsets your theories." So it was with

the extravagances of single-value men, two (and no more) values men, trade and labor union men, citizens of the world, professional negrophilists, soft-money men, and the like: they could delude themselves, and obtain more or less following for their "views," so long as sober, practical men of common sense governed affairs, and peace with honor and prosperity prevailed. But let the cyclones of panic and war, a Dakota-like change of climate and its attendant famine, or even the milder consequence of reckless municipal government (as did happen in Hamilton only one generation ago) once set in, and all was changed. Capital either became a tyrant, or, cowering, shrank away. Mr. Douglass' despised "commodities" of food and raiment became treasures beyond price; the *crescendo* of land values he affected, but only affected, to envy the possessors of real estate, became a *diminuendo*, with a *pianissimo* carefully to be underscored at the end; while as for the theories so mellifluously laid before the Institute that night—they were laid by until the tide should turn again.

THIRD MEETING.

Third Meeting, 15th November, 1890, the Vice-President in the chair.

Donations and exchanges, 33.

Dr. A. B. Macallum, in a paper on "Cell Structure and Cell Contents," referred briefly to the already known details of cell structures and the phenomena of cell division, and then gave an account of his studies on the epithelial cells of the intestine and on the cells of the pancreas of amphibia. In these cells a number of bodies are present in addition to the ordinary cell contents, and they may, according to their nature and origin, be classified as follows:—(1) parasites; (2) the remains of broken-down cells swallowed by their healthy neighbours; (3) plasmosomata extruded from the nucleus. In connection with the first class (parasites), the history of a new form of great interest was described. There is also present in the pancreatic cells of all cold-blooded vertebrates a round, oval, or elongated element situated beside the cell nucleus of a peculiar character, which, from its fibrillation and phases of degeneration, must be a parasite analogous to the forms which cause malaria in the human subject. They are absent from many of the amphibia altogether, and this is another argument for the view that they are parasitic. The new parasite discovered by Dr. Macallum has one stage in its development which resembles closely the body in the pancreatic cells, and if the latter is a parasite its degeneration and destruction in the pancreatic

cells prove that the pancreas has a hitherto undescribed function—that of a protective one. This might be the interpretation of some experiments by Italian biologists on the partial and total extirpation of the pancreas in pigeons, resulting in a diminished immunity from attacks of *Bacillus anthracis* or in a complete disappearance of immunity, according as a part or the whole of the pancreas was removed.

In regard to the other classes of intracellular bodies, the cells can be found and fixed in the act of swallowing the remains of their destroyed neighbours, and the bodies so swallowed derange the metabolism of the cells. Plasmosomata can also be found in the act of passing out of the nucleus, but what conditions favour this cannot be determined. The migration of plasmosomata from the nucleus has been again and again observed in cancer cells, and have in some cases therefore been mistaken apparently for parasites. The question of the function of the plasmosomata is connected with the origin of the digestive ferment of the pancreas. The studies on the plasmosomata of the pancreatic cells and on a compound diffused through the nucleus, show that the plasmosomata and the compound are both the primary stage of the zymogen which gathers in the cell in the form of granules, and which, again, gives origin to the digestive ferment (trypsin) of the pancreas. This indicates that the nucleus is of vast importance in the cell, controlling and directing its secretion and nutrition, and reinforces the view that the nucleus in red blood cells gives origin to hæmoglobin, and the observations of botanists, which show that the nucleus of vegetable cells builds up sugar out of carbon dioxide, and the only function of the vegetable cell itself is to convert the sugar into starch.

FOURTH MEETING.

Fourth Meeting, 22nd November, 1890, Mr. Harvey in the chair.

Donations and exchanges 73.

Mr. J. J. Mackenzie, B.A., read a paper on "The Typhoid Bacillus in Relation to Drinking Water," which was illustrated by a number of specimens. The characteristics of the bacillus were first described, then the contamination of sewage by the bacillus and its development therein. The conditions of its development in potable waters were then taken up, and the chances of the spread of a typhoid epidemic by such means explained. After this the methods used for the isolation of the bacillus were explained, and finally a number of samples given where

epidemics of typhoid had been traced to the water supply, and the typhoid bacillus afterwards isolated from the water.

Mr. Elvins referred to the amount of fever in Toronto during the last three years. He would like to know whether it had been confined to any geographical lines, or to any particular parts of the city.

Mr. Mackenzie had not been able to learn whether it had been confined to any special portions of the city or was generally scattered.

Dr. Ellis had learned that in many cases that occurred the patient had come from a house where there was a cess-pool. If it was pretty generally scattered the probability would be that it was caused by the city water. If it was confined to any special localities, one would imagine that the cases would come from the flats of the Don, but it seems that the cases came from more healthy localities, as from near Knox College.

Mr. Harvey mentioned a case that had come to his knowledge. It was from a house in Little York, that was built on a bed of gravel. Great pains were taken to analyze the water, and it was found quite pure; so that cases might occur in the healthiest locality.

FIFTH MEETING.

Fifth Meeting 29th March, 1890, the Vice-President in the chair.

Donations and exchanges, 48.

P. Jacobi and W. J. Shaw, M.D., were elected members.

Mr. R. Dewar read a paper on "The Occurrence of Gold and Silver in Galena and Iron Pyrites." He began by reviewing the geological occurrence of deposits, which he said were most abundant in the Palæozoic time in the Silurian and Carboniferous ages. He also gave the periods and epochs of all the deposits in America, which included Wisconsin, Missouri, etc. In Europe he referred to the deposits of England, Ireland, Scotland, Germany, France, Spain, Austria, and Bohemia, and remarked that iron pyrites occurred in all formations, from the oldest to the most recent. Galena occurred in granite, sandstone, argillaceous and limestone rocks, and had for its matrix quartz, fluorspar, baryta, and calcite, remarking that both galena and pyrites were found in both bituminous and anthracite coal, and in chalk and clay from the coal measures. Galena in the older metamorphic crystalline rocks was not to be com-

pared with that occurring in limestone in regard to its richness in gold and silver, also the metamorphic veins continued to a greater depth than the non-metamorphic, and that galena veins were often rich in one stratum but poor in others, providing the strata were of different composition. Mr. Dewar went on to give statistics of mines in Cornwall and Devon, and mentioned a table in Percy's metallurgy of lead regarding the presence of silver and gold in galena, which he said he did not propose to improve on. He also treated of auriferous pyrite, giving as an example the Morro Velho mine in Mimas Geraes, in Brazil, one of the richest of that country, in which the workings were on auriferous pyrites, and remarked that quite a portion of the annual production of gold was from iron pyrites. In regard to the different theories of the origin of metamorphic and non-metamorphic deposits, he found that the former originated as veins of segregation through hydrothermal fusion, and the latter as superficial deposits. In the non-metamorphic deposits the salts occurred as lead sulphate or carbonate, the silver as chloride, the gold as sulphide and chloride, while the solvent solutions were alkaline hyposulphites, chlorides, or carbonates. The paper also treated of the solvent power of ferrous and ferric sulphates in relation to gold.

SIXTH MEETING.

Sixth Meeting, 6th December, 1890, the President in the chair.

Donations and exchanges, 60.

The following Resolutions were passed :—

Moved by Mr. Hamilton, seconded by Mr. Harvey—

"That the Institute approve of the memorial presented by the Historical Section relating to the publication of documents in connection with the northern and western boundaries of Ontario. The Institute also desire to enquire if the correspondence of Governor Simcoe and the archives of the military forces in Canada at and about the period of the establishment of the separate provincial government for Upper Canada recently acquired by the archivist at Ottawa have been examined by the Government with a view to publication either in full or in abstract form as is now being done by the Province of Quebec in the case of similar documents. That the President and Messrs. Bain, Harvey, Boyle and the mover be a Committee to wait upon the Hon. the Attorney-General and bring the above matters before him and the Government."

Moved by Mr. Harvey, seconded by Mr. Hamilton—

"That the Secretary be requested to communicate with the Honorable the Provincial Secretary, asking him to inform the Government of the Province, that if they desire to purchase the Archæological and Mineralogical Museum of the late John Notman, Queen's Printer, now in the Legislative Buildings, and which is being advertised for sale, the Canadian Institute will be happy to house it and take charge of it upon the same footing as the Museum of Indian Archæology, namely, that at convenient hours, the public shall have free admission. Also that the Canadian Institute is about to consider the propriety of enlarging its building in early spring to meet the demand for enlarged space for museum purposes, and will be happy to meet the Hon. the Commissioner of Crown Lands to discuss the whole subject of a Museum of Minerals and of Natural History for the Province."

The Rev. Philip Tocque, A.M., read a paper on "Newfoundland or Terra Primum Vista." He gave a detailed account of the products and resources of Newfoundland, its timber and fisheries, and as to the minerals he said that on the western part of the country, at Codroy, St. George's bay, Bay of Islands, and other places there are gypsum or plaster of Paris, coal, iron, copper, lead, gold, silver, nickel, petroleum, flagstones, soft sandstones, limestones, marble of every quality and colour, some masses of which are four and five hundred feet in height. Here are the elements of future greatness—the elements to set in motion agriculture, manufactures, steam engines, railroads, and architecture. Here is a coal field thirty-eight miles long, ten miles broad, and three feet thick, containing 54,720,000 chaldrons, or 1,425,000 chaldrons per mile. Mr. Murray, late geological surveyor, says of three other seams having an aggregate thickness of eight feet:—"A seam of coal one foot thick would give per square acre 1,500 tons, per square mile 960,000 tons; multiply by eight and the result would be 7,680,000 tons." It is said this estimate equals the whole annual output from all the Cape Breton mines. This coal field is only eight miles from the sea, and twenty miles from St. George's Harbour, supposed to be a continuation of the coal mines of Cape Breton. A short time ago Tilt Cove, Bett's Cove, and Little Bay, on the northern part of the island, were shrouded in primeval silence; no sign of even a hamlet appeared in the horoscope of the future; but the elements of a mighty change were working, and now these places have grown into thriving villages. All appeared poverty on the surface, but glittering chambers of wealth were below.

Governor Hill, in his annual report to the Colonial Office in London, gives an interesting account of the rapid growth of these villages and of

the mines which he had visited. The Tilt Cove copper mine yielded in 1868, 8,000 tons of copper ore, which sold for $256,000. In 1869 a fine vein of nickel was discovered, intersecting the copper, from which ore was taken which realized $38,600. In 1879 Tilt Cove mine yielded nearly 50,000 tons of copper ore, valued at $572,154. The mines at Bett's Cove and other places amounted to 23,556 tons, the whole valued at $2,982,836. Little Bay is said to have one of the most valuable copper mines in the world. Up till 1879 the total amount of copper ore exported from all the mines amounted to $5,000,000. There is a pure galena mine at La Manche, of which Bishop Mallock says :—"Once while I was there 65 tons of lead were shipped off, and another time I saw 100 tons of dressed ore in barrels prepared for exportation." The sheriff of the Northern Circuit Court writes :—"Every day new discoveries are being made. Mining has been commenced at Southern Arm, Rouges Harbour, and Burton Pond. At present it is difficult to prognosticate what the future of this country will be." There is no doubt but that thorough and extensive prospecting would bring to light hidden treasures of immense value for the investment of capital. Careful explorations would show that copper deposits are not confined to Green Bay. Copper ore is known to exist in Conception Bay and other places. Mining generally in Newfoundland is an industry of great promise.

SEVENTH MEETING.

Seventh Meeting, 13th December, 1890, Dr. Meredith in the chair.

Donations and exchanges, 39.

Mr. Edward Meek was elected a member.

Mr. Arthur Harvey, Delegate to the Montpelier Congress on the Romance Tongues read his Report with remarks on some ancient races still existing in southern Europe, their languages and customs. The fact of the survival in France of several old races, whose physical characteristics and whose languages differ from what is adopted as the French standard was illustrated in reference not only to the Breton population, who are almost the only sailors France possesses, and who still speak a Celtic tongue, but also to the population of Southern France. The Roman type existing around Nimes and the Greek features and ways of the Marseilles folk were noted and commented upon, and the history of the Roman and Greek colonies in those places was discussed, with references in each case to the Latin and Greek authors

to whom we owe the original accounts. Mr. Harvey introduced to the Institute the modern Provençal poet, Frederic Mistral, whose charming volume, "Mireio," has been translated into French and English. He outlined the plot of this remarkable work and favoured the members present with specimens of the original Provençal—with metrical translations by himself of the portions quoted.

A cordial vote of thanks was tendered to Mr. Harvey for the valuable services he had rendered the Institute as delegate and for his very scholarly and interesting report.

EIGHTH MEETING.

Eighth Meeting, 20th December, 1890, Mr. Harvey in the chair.

Donations and exchanges 78.

Mr. James McNally was elected a member.

Mr. Harvey read the Report of the Committee on Historical Documents, which stated that they had an interview with the Hon. the Attorney-General and other members of the Ontario Government; they had been received with courtesy and attention, and have been requested to prepare in writing a list of the Historical and other documents they considered worthy of publication.

On motion of Mr. Hamilton, seconded by Mr. Browning, it was resolved, That the report of the Special Committee appointed by resolution passed on the sixth of December instant, be received and adopted, and that the said Committee be continued in office till the end of the current Institute year, and be instructed to obtain and submit to the Hon. the Attorney-General such further information, and take such other means as may lie in their power (not involving expense to the Institute) as they may deem advisable to carry out the objects of the resolution appointing them.

Mr. Fred. A. T. Dunbar read a paper on "Sculpture."

NINTH MEETING.

Ninth Meeting, 10th January, 1891, the President in the chair.

Donations and exchanges, 210.

A letter from the Secretary of the Royal Society of Canada respecting the meeting of the Society in Montreal on the 27th May, 1891, was read and referred to the Council.

A paper by H. R. Wood, M.A. was read entitled "Crystal Studies, No. 1."

Mr. W. A. Sherwood, read a paper on "Colour in Nature in Relation to Drapery." He said that there was no element in the whole range of Nature's phenomena more universal than that of colour. Her forests, mountains, rivers, the plumage of birds, the blossoms of trees, and the whole of the flowery kingdom display the splendour of Nature's adornment. From this source of exhaustless materials the colors of our drapery should be chosen. Nature and not the fashion plate should alone guide us in the choice of colour. Costumes should have a distinct range of colour suiting the conditions of complexion and in harmony with our surroundings. For evening wear in our homes all that would suggest brightness, varying in every range of tint and tone, from the pink and pretty pale green tones of the costumes of children to the rich, deep moss green cloak fringed with gold lace and silvery-hued borders for those of riper years, should be worn. Deep crimson with warm brown tones, might happily replace the cold grey and black suitings of to-day.

Mr. Sherwood then referred to the different epochs of British history. Beginning with the Danish invasion, he said the first use of black began with these warriors of the North, their crest being the raven. Its presence, however, did not long hold in Britain. The Normans wore different colours. Edward III. declared for a distinct arrangement of colour and material for all of his subjects from the royal household down to the peasant, imposing heavy fines for the violation of his decree. In the Tudor period a great revival was effected in the colour of costumes. Velvets of warm purple, fringed with gold lace, and indeed all the primary colours were worn. The masterly dramas of Shakespeare were penned in such society. "Rare Ben Jonson," Sir Walter Raleigh, and Lord Bacon each selected for himself from the draper's shelf. Fairholt, in his "British Art," pays the highest tribute to the court of Charles I. for elegance and grace and picturesqueness of costume, denouncing at the same time the plainness of the Puritanic dress. This plainness, he asserts, was but the vulgar affectation of modesty. Dark drab, grey, and black became the prevailing colours from the ascendancy of Cromwell to the present time; with but short intervals this arrangement has been firmly fixed. By the harsh enactments of Cromwell the loose mantle of the Irish was torn off, but happily the heather hills, with their sturdy

clans, withstood the invasion, and have to this day the tartan plaid kilt and hose of undated epochs. The Puritan violated every line of grace, treading under foot every form of beauty and colour. Under this *regime* painting and sculpture degenerated. Square cut coats, slouching hats, and ugly boots were declared modest and proper and "pleasing unto God," as though the Creator of all that is beautiful should smile the more upon the violation of His divine laws of grace and colour.

In conclusion, Mr. Sherwood said often as he looked down the aisles of the church he could not help thinking, as he saw masses of drapery black as night and sombre as the grave, that the effect must be far from cheerful to many weary souls. The temple of God ought to be graced by the richest ranges of colour, being indeed a true counterpart of God's own house, the temple of nature.

TENTH MEETING.

Tenth Meeting, 17th January, 1891, the President in the chair.

Donations and exchanges, 66.

The following specimens were presented to the Museum :—Trilobite by Mr. McKay; Globigerinae and shells, piece of Labradorite, and Boeothick ornaments by Mr. Harvey.

The following were elected members :—John Young, G. A. Chase, B.A., Charles Rust, C.E., Robert M. Dennistoun and C. W. Armstrong.

A letter was read from the Governor-General's secretary, enclosing a despatch received from the Colonial Office relative to a memorandum by Dr. Sandford Fleming, C.M.G., on the "Movement for reckoning time on a scientific basis, by which the greatest possible degree of simplicity, accuracy and uniformity will be obtainable in all countries throughout the world." This memorandum had been transmitted by the Canadian Institute to the Colonial Office, and submitted to the Department of Science and Art, which reported the following resolutions, passed at a meeting of the Committee on the Prime Meridian Conference, held on the 25th April, 1890, there being present—the Astronomer Royal (in the chair), the Hydrographer of the Navy, and General Donnelly, C.B :— "Resolved (1) that it is desirable that Mr. Sandford Fleming's memorandum be forwarded to the Governments of all the colonies for their consideration, with a view to the adoption of the Hour Zone system in reckoning time generally, and of the 24-hour notation for railway time-

tables. The committee desire to express their concurrence in Mr. Sandford Fleming's views as to the advantages which would result from this reform, and the ease with which it could be carried out. (2) That it would be advisable that a similar recommendation should be forwarded to the Indian Government, and that the adoption of the 24-hour notation for railway time-tables (which they understand has been adopted on several lines in India) should be recommended to the railway companies of the United Kingdom."

The Secretary was instructed to write to the Governor-General and call attention to the circumstance that the circular is directed to the colonies only, and request that the attention of foreign nations be directed to the circular.

A letter was read from Sir Daniel Wilson, stating that Dr. Sandford Fleming, having failed in his arrangements with The Canada Life Assurance Company to place the sum for which his life was insured at the immediate service of The Canadian Institute, had sent his cheque for $200, and proposed to pay the same amount annually as interest on the capital sum.

Moved by Professor Loudon, seconded by Dr. Kennedy, and carried,

" That the Canadian Institute has once more to acknowledge the interest and appreciate the kindness of one of its earliest and most distinguished members, Sandford Fleming, C.E., LL.D., C.M.G., who, during the whole period of his connection with it, has shown a deep and unflagging interest in all that concerns its welfare and prosperity, and who has ever been foremost in all movements pertaining to the advancement and extension of the work of the Institute. In addition to his generous provision of a paid-up policy of life insurance for the sum of $4,000 towards the funds of the Institute, he has given further evidence of his kindness in desiring to pay to the Institute yearly the interest on the above sum. Wherefore be it resolved that the best thanks of the Institute be tendered to Dr. Sandford Fleming for this fresh token of his interest in the Institute, that a copy of this resolution be sent to him."

Dr. A. B. Macallum read a Paper entitled " Studies on the origin of the Blood Pigment." The results given in the paper were obtained from an investigation extending over several years. The main points of the paper on the structure of the cell nucleus and of the compounds which it contains may be summarized as follows:—One of the nuclear compounds, the substance chromatin, so called because of its capacity for absorbing staining reagents, and confused by the chemist and biologist with a derivative of it, nuclein, constitutes the fundamental life substance

of the cell, and in it all the vital processes originate. When it is abundant the cell is vigorous or it is highly endowed vitally, and this is especially the case in embryonic cells. This substance is transferred from the maternal organism to the tissues of the embryo either through a special organ, the placenta, directly, or indirectly by means of the yolk of the egg in lower animals. The yolk contains a comparatively large quantity of the chromatin, and this is transferred to the embryonic organs partly by wandering cells, which absorb it and carry it thither. These wandering cells become gorged so to speak with chromatin, and they constitute the hæmatoblasts, or young blood corpuscles. Of the chromatin, which these corpuscles utilize a portion is converted into hæmoglobin, and this is the only source of that pigment in young blood corpuscles. As hæmoglobin contains iron, Dr. Macallum concluded that chromatin also possesses it. In the preparations of various kinds of chromatins iron could not be detected, but it was readily recognized in the ash of the substance. Dr. Macallum has quite recently found a way of detecting the iron of the chromatin in the intact nucleus. From all these observations it is proved that the fundamental life substance of the cell is a compound in which iron is present and more firmly combined than it is in hæmoglobin. As the latter is an oxygen carrier it may be concluded that the chromatin of every cell absorbs oxygen, and that through this the respiratory and chemical changes of the cell are brought about. The question of the absorption of iron in the body was also taken up, and facts were related which showed that the iron of the chromatins of the body comes into the system through the chromatins of the food, which the administration of iron or iron salts as therapeutic reagents protects from decomposition.

ELEVENTH MEETING.

Eleventh Meeting, 24th January, 1891, Mr. Harvey in the chair.

Donations and Exchanges, 54.

Ernest Cruickshank, George Mickle, B.A., R. P. B. Joyce, and E. C. Jeffrey, B.A., were elected members.

Dr. Canniff was added to the Committee on Historical Documents.

A communication was read from the treasurer of the International Congress of the Geographical Societies, to be held at Berne from the 1st to the 15th of August next, giving the programme of the congress and inviting the co-operation of the Canadian Institute and the presence of its members at the proceedings.

Mr. D. R. Keys, M.A., read, on behalf of Mr. A. F. Chamberlain, M.A., Fellow in Clark University, Worcester, Mass., a paper entitled, "African and American; the contact of the negro and the Indian." He said :—The history of the negro on the continent of America has been studied from various points of view, but in every case with regard to his contact with the white race. It must therefore be a new, as well as an interesting inquiry, when we endeavour to find out what has been the effect of the contact of the foreign African with the native American stocks. Such an investigation must extend its lines of research into questions of physiology, psychology, philology, sociology, and mythology.

The writer took up the history of the African negro in America in connection with the various Indian tribes with whom he has come into contact. He referred to the baseless theories of pre-Columbian negro races in America, citing several of these in illustration. He then took up the question ethnographically, beginning with Canada. The chief contact between African and American in Canada appears to have taken place on one of the Iroquois reservations near Brantford. A few instances have been noticed elsewhere in the various provinces, but they do not appear to have been very numerous. In New England, especially in Massachusetts, considerable miscegenation appears to have taken place, and in some instances it would appear that the Indians were bettered by the admixture of negro blood which they received. The law which held that children of Indian women were born free appears to have favoured the taking of Indian wives by negroes.

On Long Island the Montauk and Shinnacook Indians have a large infusion of African blood, dating from the times of slavery in the Northern States. The discovery made by Dr. Brinton that certain words (numerals) stated by the Missionary Pyrlaeus to be Nanticoke Indian were really African (probably obtained from some runaway slave or half-breed) was referred to. In Virginia some little contact of the two races has occurred, and some of the free negroes on the eastern shore of the Chesapeake peninsula show evident traces of Indian blood. The State of Florida was for a long time the home of the Seminoles, who, like the Cherokees, held negroes in slavery. One of their chiefs was said, in 1835, to have had no fewer than 100 negroes. Here considerable miscegenation has taken place, although the authorities on the subject seem to differ considerably on questions of fact. In the Indian Territory, to which Cherokees, Seminoles, and other Indian tribes of the Atlantic region have been removed, further contact has occurred, and the study of the relations of the Indian and negro in the Indian Territory, when viewed from a sociological standpoint, are of great interest to

the student of history and ethnography. The negro is regarded in a different light by different tribes of American aborigines. After mentioning a few isolated instances of contact in other parts of the United States, the writer proceeded to discuss the relations of African and Indian mythology, coming to about the same conclusion as Prof. T. Crane, that the Indian has probably borrowed more from the negro than has the negro from the Indian. The paper concluded with calling the attention of the members of the Institute to the necessity of obtaining with all possible speed information regarding :—(1) The results of the intermarriage of Indian and negro; the physiology of the offspring of such unions. (2) The social status of the negro among the various Indian tribes; the Indian as a slave-holder. (3) The influence of Indian upon negro and negro upon Indian mythology.

TWELFTH MEETING.

Twelfth Meeting, 31st January, 1891, Dr. Kennedy in the chair.

Donations and Exchanges 48.

A letter was read from the Governor-General's secretary, acknowledging the receipt of a communication from the institute on the subject of "Cosmic Time," and conveying the information that, in accordance with the suggestion of the Council of the Canadian Institute, his Excellency is taking steps with a view of bringing the correspondence which has passed relative to this matter to the notice of foreign powers, through her Majesty's Secretary of State for Foreign Affairs.

A paper on "Canadian Art of To-day" was read by Mr. J. W. L. Forster. He gave a list of brilliant Canadian names in the art roll of other nations—The Smillie brothers, Leclear, Woodward, Rattray, Sandham, Fraser, Walker, Glazebrook, Shannon, Peel, and others. During those years our field has been occupied by men from the old world—Bull, Hoppner Meyer, Paul Kane, Hamel, Krieghoff, Wandsworth, Westmacott, March, Hunt, Gush, Sawyer, Fowler, Creswell, Berthon, and many more. "Pilgrims, as all our fathers were," yet they helped to plant a stem in the soil of our country from whose vintage we drink to-day. Their style was mostly that of the British artists of their day. Their patrons were men whose tastes were the outgrowth of the same associations. Exhibitions held within the fresh memory of many were filled with examples of that careful academic work. Though the old tastes have largely died away with the old legacies that sustained them,

and an interim has passed in which little that was characteristically old or new was produced, there has never been an absolute dearth of pictures or of purchasers. Yet there was a long pause during the years when colonial life allowed little leisure for the culture of the æsthetic, and little means for its encouragement. Few artists remained. Paul Kane, the famous explorer, was being forgotten and neglected. Sawyer and Creswell barely lived and have passed away ; Mr. Berthon's venerable hand still does honour to the Toronto Law Society in portraits of our eminent jurists. The Toronto Law Society, inheriting, as many of its members do, both the blood and the traditions of the distinguished founders of our local commonwealth, has kept alive the spirit of a generous age.

The first, or Upper Canada Art Society, was formed in 1841, and existed but a short time. The next was the Electoral Division Society, which held a few exhibitions, offering competitive prizes to both professional and amateur artists. The Agriculture and Arts Association assumed the patronage of the Fine Arts, and for years held the gauge of professional merit. In 1873 was formed the distinctly professional group known as the Ontario Society of Artists, and which, during these eighteen years, has placed annually before the citizens of Canada the best work of our artists. Two years before that date was formed the Art Association of Montreal, and in 1880 was formed in Ottawa the Royal Canadian Academy. The art of Canada to-day is a mingling of elements. Though they are as truly Canadian as we who first saw the sun in our own sky, yet among the fifty members of the Ontario Society of Artists not more than six or eight are native Canadians. Not only are the influences of the Old World evident in the work of most of our painters, but even our native artists, whose schooling has been abroad, are disposed to paint a Canadian sky with the haze of Western Europe.

Mr. Forster referred to the recent awakening of a national sentiment amongst Canadians as one of the most hopeful promises for the Art of this country. And the establishment by both Government and citizens of schools of industrial and fine art has in it the assurance of advancement in the direction of national art. One of the greatest needs of our country is a museum equipped with well-chosen specimens of the world's art.

Mr. Sherwood spoke of the necessity of infusing a national sentiment into Canadian art. He referred to Paul Kane as an artist in whom the spirit of nationalism was strong. He thought that a better day was dawning, and that there was a splendid future for Canadian art.

Mr. T. R. Clougher thought that one cause of the depressed state of Canadian art was that we lacked art critics. There were good critics and

well acquainted with art, but they lacked the power of expressing their ideas. In order to have a national art we must have a national sentiment. There were a large number of historical subjects relating to Canada that were never touched by our artists. If Canadian artists would give us such works they would soon find a revolution in art.

Mr. Forster said, in regard to competent art criticism, there was no lack of men with the true inwardness of art and the power of conveying their ideas, but the remuneration afforded by our magazines was not such as to induce them to take up the subject. He hoped that men of the right stamp would soon enter the arena.

Mr. Revell read a paper by Mr. Arthur Harvey, advocating the establishment of a national school of art, shewing its importance and possibility, and pointing out the vast range of subjects in nature, and historical incidents that awaited the genius of the Canadian artist. He also referred to the benefits to be derived by artists from contact with scientific and literary men, and the study of various branches of science. He instanced the case of an artist who was better able to paint the clouds from a knowledge of meteorology. So in geology and other branches of science.

THIRTEENTH MEETING.

Thirteenth Meeting, 7th February, 1891, the President in the chair.

Donations and Exchanges 157.

The council reported the election of Mr. Harvey A. Hunter as an associate, and the following associates were elected members :—Herbert H. Brown, John L. Jackson, J. Maughan, Jr., and Ernest C. Tyrrell.

A communication was read from "L'Academie Royale des Sciences, des Lettres, et des Beaux-Arts de Belgique," announcing the death of its permanent Secretary, M. le Lieutenant-General en retraite, Jean-Baptiste Joseph Liagre, ancien Ministre de la guerre, &c.

The committee of the Institute entrusted with the duty of complying with the request of the Hon. the Attorney-General and other members of the Government of Ontario, to be informed what historical documents the Institute thought worthy of the consideration of the Government, with a view to their publication, presented their report. They enclosed a letter from Mr. Douglass Brymner, the archivist of the Dominion at Ottawa, in answer to a communication from the committee, which they recommended to be submitted to the Government.

The Hon. William Proudfoot read a paper upon "Some Effects of Christianity on Legislation." Noting the difficulty of stating that any recent legislation could be selected as an outcome of Christian principle, without being met by the objection that it was as probably due to the general advance of civilization, to the progress of the human mind, to reasons of State or expediency, perhaps to the exigencies of party strife, he directed attention to those earlier times when Christianity, after more than three centuries of oppression, neglect, and persecution, during which its teachings and the pure lives and devotion of its worshippers had spread their beneficent effects in an ever-widening range, at length numbered the rulers of the world among the disciples of the Cross.

The laws particularly referred to were those having for their objects: The preservation and protection of infants; the support of the poor; the establishment of hospitals for the sick and incurable; the encouragement of the emancipation of slaves; the prohibition of gladiatorial combats; and the mitigation of punishments. That these were all duties inculcated by the Christian religion was established by a number of texts from the Scriptures. With what had these principles to contend? The Romans had long been renowned for their supremacy in the arts of peace as well as of war. But one of the institutions peculiar to them was that of the Paternal Power, or, as Livy terms it, the Paternal Majesty. A historian sums up the particulars of this authority as permitting fathers to beat their children with whips, to confine them in prison, to make them work in chains in the fields, to sell them, and in fine to kill them. The father was a family magistrate with the power of the sword. In later times the supreme authority was rarely exercised. But it was in full force in Cicero's time, when Fulvius, the son of a Senator, was slain by his father's command for conspiring against his country with the followers of Catiline; and at a later period Erixo whipped his son to death, and Hadrian banished a parent for killing his son. In the early part of the fourth century the practice of killing, exposing, selling, and pledging infants had become very prevalent in Italy.

Constantine the Great was the first Christian Emperor, and in the year 313 he issued an edict granting toleration to the Christians. With the view of deterring parents from destroying their offspring he provided in 315 (amended 322) that poor parents suffering from want of food and clothing might procure food, clothing, and necessaries from the public funds and from the private fortune of the Emperor. This law and several others of the same year are supposed to have been suggested by Lactantius, a Christian of great eminence for his learning and eloquence, and then the tutor of Crispus, the son of the Emperor. A

number of statutes in subsequent years were referred to for the purpose of more fully protecting infants. Before Constantine's time no provision was made for the poor, or for the sick, the helpless, the incurable. No hospitals, no poorhouses. The enactments in their favour are to be considered in connection with grants to churches. These grants were made usually with an expressed intention that they were to be employed for charitable purposes. Generally the property of the Church was declared to be inalienable: but even the most sacred property could be sold for these purposes. As soon as Christianity was freed from persecution, establishments sprung up with wonderful rapidity for the reception of travellers and sojourners, for the poor, for orphans, for foundlings, for the aged, and for the sick.

In 314 Constantine abolished the punishment of crucifixion, and in 315 that of branding criminals in the face. He also abolished the punishment of throwing the criminals to wild beasts and the bloody spectacles of gladiatorial combats in 325. Slaves abounded. Their lot was a hard one. Their masters could kill them without danger of punishment. Their condition was somewhat ameliorated before the time of Constantine. Hadrian forbade to kill them, but chastisements continued still to be immoderate. The law restricted this, and the punishments he prevented show what were actually in use—killing with a heavy stick, a stone, a javelin, or subjecting to torture, to claws, nails, red hot metal plates, the rack. Masters using these and causing death were to be guilty of murder, and provision was made for encouraging emancipation.

FOURTEENTH MEETING.

Fourteenth Meeting, 14th February, 1891, Prof. Ellis in the chair.

Donations and Exchanges 35.

Robert Jenkins and T. H. Ince were elected members.

A paper by H. R. Wood, M.A., was read, entitled "Crystal Studies, Nos. 2 and 3."

Mr. Alan Macdougall, C.E., read a paper on "The Bœothick Indians" of Newfoundland. The chief facts were supplied to him by Rev. M. Harvey, of St. John's, Newfoundland. This tribe, at one time aboriginal inhabitants of the island, can now only be counted by one or two skeletons and a few skulls, so completely have they been swept away. The French employed the Mic Mac Indians from Nova Scotia to fight against

and exterminate them. The Bœothicks were a peaceable and quiet race given to hunting and fishing. They used canoes made of birch rind, and of the skins of deer like the Esquimaux cayak. They were not potters, their utensils, culinary and drinking, were of birch rind sewn together by small roots of the birch. They used soap-stone dishes for lamps, which were well shaped and carefully made, the form being similar to that in use among the Esquimaux of the present day. They carved the horn of the deer, walrus, and bones of the seal into a number of ornaments, which they wore on their dresses, and ornamented their heads with combs. The carving is in triangular patterns, and out of the large collection in the museum at St. John's there are not two ornaments having the same pattern. The patterns seem to run in the shape of the letter H. They used flint arrow heads. Their stone implements were more rudely constructed than those of the Western Indians. No specimens of wampum belts or totems or pipes exist.

FIFTEENTH MEETING.

Fifteenth Meeting, 21st February, 1891, the President in the chair.

Donations and Exchanges 85.

Professor Andrew J. Bell, Ph.D., C. H. Needler, Ph.D., and Adam. H. Meyers were elected members.

A communication was read from the Committee of Organization of the Fifth International Congress of Geologists, which will be held at Washington on the last Wednesday (26th) of August, 1891, containing a cordial invitation to the members of the Canadian Institute, and all interested in the subject, to take part in the labours of the congress. The annual meeting of the American Association for the Advancement of Science, and the summer meeting of the Geological Society of America will be held in the same city during the preceding week.

W. H. Van der Smissen, M.A., read on behalf of Rev. Neil MacNish, D.D., LL.D., of Cornwall, a paper entitled, "A Review of a Work by A. W. Moore, M.A., on Surnames and Place-Names of the Isle of Man." This book of Mr. Moore's has recently been published, and contains very useful information, not for Manxmen merely, but also for Celtic scholars everywhere. "My aim," says the author, "is to give a complete account of the personal names and place-names of the Isle of Man." Mr. Moore is a gentleman of scholarly attainments, who has devoted much attention

to the literature and topography of the Isle of Man, and has earned an honourable reputation for his patriotic efforts to revive and perpetuate whatever is of value in the history and literature of his native island. This little island can at least boast that it has preserved its independence unimpaired, and that it still possesses its old legislature, which had its origin before the Battle of Hastings. Fifty thousand people still retaining their old laws and their old customs in the centre of the United Kingdom is a spectacle as unique as it is notable. Their annals necessarily possess a peculiar interest to the antiquarian and the historian. There was formed in 1858 a society bearing the designation, "The Manx Society, for publication of national documents of the Isle of Man." Up to 1886 twenty-nine volumes were published by that society. Mr. Moore divides the history of Man into three parts :—(1) When it was inhabited by a Celtic people exclusively. (2) The period of the Viking invasions and the establishment of Scandinavian rule. (3) The period during which Man came under English dominion. It is found that in nearly every case Scandinavian names are Celticized, *i.e.*, they have received the prefix "Mac." It does not appear that "O" ever took root in the Isle of Man, though "Mac" was widely prevalent. Mr. Moore avers that surnames in Europe may generally be divided into four classes :—(1) Those taken from the personal names of an ancestor. (2) Those taken from trades and occupations. (3) Those which originally indicated place of birth or residence. (4) Those which were originally descriptive of a person's appearance in character and residence. It has been ascertained that of the surnames which are now in use in man 68 per cent. are purely Celtic Numerous examples were given by the writer of the various classes of names with their signification. Mr Moore's book cannot fail to find a very honorable place among the comparatively few books that are of highest value and that are most highly prized in connection with the early monuments and character and varied development of the several divisions of the great Celtic family.

SIXTEENTH MEETING.

Sixteenth Meeting, 28th February 1891, Mr. Browning in the chair.

Donations and Exchanges 46.

Mr. T. B. Browning, M.A., read the third of a series of papers on the "Codification of the Law," with special reference to "contracts." In opening he paid a tribute to the great codifier whose untimely fate has

cast a pall over the English-speaking world, and adverted to the fact that the later or historical school of legal thought in England, of which Judge Stephen is so prominent a member, is pronouncedly in favour of codification. He confined himself to two aspects of his subject, definition and division: (1) What is a contract in English law? (2) How should contracts be classified? (1) As an objective point Addison's definition was taken, that a contract is "an agreement by which two parties mutually promise and engage, or one of them promises and engages, to the other to give some particular thing or to do or abstain from doing some particular act." While a skilled profession may work well with almost any kind of instrument this definition is inadmissible for codification purposes. It is too wide, too narrow, and unsuited to our law. It is too wide because it includes gifts and agreements without consideration, which are not contracts, and practically necessitates a division of the subject into contracts valid and contracts invalid, illegal or void, the latter of which are treated by way of exceptions, under such headings as fraud, mistake, misrepresentation, or the vaguer term of public policy. The exceptions outweigh the rule, and are in themselves cross divisions. Mr. Greenwood gives 580 sub-classes of exceptions coming under public policy without exhausting his subject. But, as Mr. Holmes shows, a void contract is no contract at all. The Indian codifiers when face to face with the problem limited their definition to agreements "enforceable at law," and are followed by later text writers. The definition is also too narrow. A little straining of language may bring the greater number of unilateral contracts under the head of "agreements," but not so records, the highest form of contract; nor implied contracts, one of its chief divisions; nor enforceable claims under statutes, charters, by-laws, a department of law which, particularly in respect to companies, is rapidly increasing and must continue to develop as industrial processes multiply and consolidate. Thirdly, Addison's definition is taken from the French writer Pothier, is a summation, in its legal form, of the theoretic individualism so prevalent last century on the European continent, and is an exotic imposed on our legal system. While individual right is a wide and growing principle in our contractual law, the idea of duty or obligation in the wider sense is anterior to it in point of time, and of more general operation to-day. The very word contract is of late date with us. Our law of contract has three stages of development: obligations created and enforced by law analogous to *status:* those created by act of parties in presence of or with the permission of the court: the extension of this idea, by way of analogy, to acts of the parties outside the court, at first within strict, then within wider limits, but never at large. The placing of agreement

in the foreground as the principal element of contract is a reversing the natural or historical order of English law, and compels resort to the unscientific expedient of alternate expansion and limitation. Contract is to be defined from the standpoint of duty or obligation in the wider sense, the essential element of which is the formation of a legal bond or tie. (2) The long-established classification of English law, which places records in the first-class, accords with this theory. The distinction between contracts under seal and those not under seal, once important, has broken down from many causes: the more general education of the people, the reduction of seals to attenuated ghosts of their former selves and loss of distinctive character, intervention of the common law and Chancery Courts and statute to prevent fraud; followed by the amalgamation of the courts. Seals may continue for solemnization purposes and for evidence, but the affixing them to contracts should no more constitute these a class apart than the requirement of writing should make contracts coming under the statute of frauds a separate class from other simple contracts. In matter of substantive law the tests of the validity of both are identical. Reviewing Mr. Amos' list in respect to the distinction between status and contract, Mr. Browning classified contracts under two main heads; acts of the law immediate, acts of the law mediate.

SEVENTEENTH MEETING.

Seventeenth Meeting, 7th March 1891, the president in the chair.

Donations and Exchanges 75.

Mr. Levi J. Clark read a Paper entitled "A consideration of Sewage Schemes." He took up the subject under three heads: (1), A general survey of the position of sewage affairs in various parts of the world, particularly in England and Germany; (2), An elucidation of a gravity scheme for Toronto; and, (3), Some general defects in sewage works, and also some remarks on weak points in the scheme now before the city. Under the first heading he reviewed a recent work on sewage by W. Santo Crimp, assistant engineer of the London County Council, England. The book contains valuable information regarding the various methods of sewage disposal, such as sewage farming, precipitation works, filtration, irrigation, chemical treatment, electrolysis, and free outfall into the sea or other large body of water.

The general conclusion that Mr. Crimp comes to is that where a free

outfall can be obtained into the sea or other large body of water that is the cheapest way of disposing of sewage. Indeed, a novel method is proposed for the city of London, namely, to transport it in steamships constructed for the purpose out into the channel and dump it into the sea. This is supposed to be the most speedy, cheap, and cleanly way of disposing of it.

Where places are situated on tidal waters these can be utilized for the purpose of scouring the outlet pipe and carrying all offensive matters far out to sea. It was a consideration of the foregoing methods of sewage disposal, of which Portsmouth, England, affords a good example, which led Mr. Clark to devise a scheme which would secure the advantages of tidal waves and avoid the expense of pumping. By means of a high-level sewer along Gerrard street, extending from Yonge to Parliament streets, connected with a large automatic flushing tank, a head of 32 feet could be secured instead of 10 to 12 feet, the ordinary height of the tides around England. Then instead of twice a day the flushing could take place every hour in the day if desirable. From four to eight large flushes of half a million gallons each would be ample to keep the outlet pipe scoured.

Mr. Clark showed by illustration on the blackboard why deposits take place in sewers that are constructed too large. He also explained a formula of his own by which to determine the velocity of sewage flowing in sewers partly full. This is a fact too often lost sight of, and to which is attributable many of the present defects in drainage.

Mr. Clark also read a paper, "A Few Words on Lake Currents." He held that there are no regular, constant, well-defined lake currents, but that these are variable, dependent on the conformation of the shore and the storms that affect the surface. This is important in view of the proposal to discharge our sewage into the lake. The effect of a continued strong easterly gale is to drive the surface water to the west, where it piles up on the shores at the western end at Hamilton beach, and by the head thus produced a portion of the water is forced backward as an undertow, thus producing a current in the opposite direction to the waves on the surface. This undercurrent then in flowing to the east would first pass the intake of Toronto water supply, and then pass the contemplated place of discharge of sewage, so that a sewage outfall to the east would in no way endanger the water supply. When the winds were in the contrary direction it would not produce a counter-current below, as the outlet is towards the east, and as the waters flow down the lake they would make their exit by the St. Lawrence. This makes plain the danger that would arise from having sewage disposal outlets to the west.

Mr. Macdougall referred to the great importance of the question of Lake Currents. The matter had not been sufficiently investigated. He gave a table of float observations taken off Victoria Park, six miles east of Toronto, in October, 1888 :—

Oct. 22nd, light east wind,	30 feet deep,	3hrs. 40min.,	½	mile	east.
" " " "	50 "	4hrs. 30min.,	¾	"	
" 30th, light west wind,	surface	2hrs. 5min.,	¾	"	
" " " "	50 feet deep,	2hrs. 45min.,	⅔	"	
" " " "	70 "	3hrs. 00min.,	½	"	
" " " "	100 "	3hrs.	200	yds	west.

The floats were of canvas, cross-armed, 4 feet. long, 15 inches deep.

In September, 1887, he took a few temperature observations of the lake on the sailing course from Niagara to Toronto. The summer of that year was remarkable for its great heat.

	Depth.	*Shade.*	*Surface.*	*Deep Water.*
At mouth of river,	30 feet	65°	65°	66°
3 miles out,	30 feet	65°	65°	66°
4½ miles out,	50 feet	65°	65°	63°
7 miles out,	175 feet	60°	64½°	48°
7½ miles out,	100 feet	60°	64½°	45°
	240 feet			43½°
9 miles out,	100 feet	61°	64½°	44°
	200 feet			42°
	275 feet			42½°
10½ miles out,	100 feet		66½°	42°
	200 feet			42°
	325 feet			41°
12 miles out,	50 feet		65½°	50°
" "	200 feet			42°
" "	350 feet			41°

EIGHTEENTH MEETING.

Eighteenth Meeting, 14th March, 1891, Mr. Harvey in the chair.

Donations and Exchanges 45.

Letters from the Town Councils of Penetanguishene and Midland inviting the Institute to hold its summer meeting at those places, were read and referred to the Council.

The Geological and Mining Section reported the following resolution:— "We are of opinion that until a provincial department of mines is established the mining and metallurgical interests of Ontario cannot receive that attention which their importance demands, and therefore recommend that a mining convention be called to meet in the City of Toronto, at the Canadian Institute, on the 31st day of March, at 10 a.m., to consider measures for the advancement of the mining industry, and the advisability of establishing a provincial department of mines. The Canadian Institute is hereby requested to give notice calling upon the various mining localities throughout the province to send delegates to meet the delegates appointed by the Institute for the purpose of laying their views before the Provincial Government." It was resolved that the institute adopt the resolution passed by the Geological and Mining Section, and refer it to that section to carry out the details.

Mr. David Boyle read "A Summary of the Archæological Report for 1890-91." He referred to the increased interest in matters relating to archæology, the discovery of many valuable ethnological facts in connection with the year's operations of the Institute, and the large number of specimens that had been added to the Provincial Museum during that time.

Mr. Boyle also read a paper by Mr. G. E. Laidlaw on "Indian Remains and Relics Found in the Neighborhood of Balsam Lake." In illustration of the statements made he exhibited several remarkably beautiful, curious and instructive specimens of aboriginal workmanship, forming part of the Laidlaw collection in the museum. There was also on view a unique specimen of Hydah wood-carving, in the shapeof a group of three animals, the central and chief of which is a seal, about five feet in length, and supported at each end by fantastically cut figures. Mr. Boyle explained that this specimen came from a remote island in the Queen Charlotte archipelago, and had been secured for the Institute through Mr. W. H. Jones of the Vancouver *World*. A small canoe model from the same place was also shown. Both specimens are painted in red, white and black, after the manner peculiar to Hydah artists.

Mr. J. W. L. Forster said there seemed something pathetic in the artistic efforts of these rude people. There was a striving after some higher ideal amid their antagonistic surroundings. There was a striving after the arts of peace amid the contentions of savage tribes. The brotherhood of man was here brought out in these rude efforts of art.

Mr. Arthur Harvey referred to the mounds in Florida. They were 100 feet in height and 100 feet across. The only things now found in them are shells. These shell mounds are similar to those now found in

Denmark and in other places. It was remarkable that copper implements were found in them, and some gold. These metals are not produced in Florida. He had no doubt that the copper came from the north-west of Lake Superior, and the gold from Mexico, indicating the intercommunication between the tribes. In the shell mounds of Jamaica no gold was now found, though the Spaniards found gold there, which probably came from Mexico.

NINETEENTH MEETING.

Nineteenth Meeting, 21st March 1891, the President in the chair.

Donations and Exchanges, 111.

Mr. Harvey presented a dragon-fly from Bogota, Columbia, from Mr. Croll of the SS. "Alene," also a gamboge apple and shells from Jamaica. The Rev. Vincent Clementi, B.A., of Peterborough, having written offering to present to the Natural History Department of the Institute a work entitled "The Nests and Eggs of the Birds of Ohio," and to have the same bound at his own expense, a resolution was passed accepting the same and returning thanks for the valuable gift.

Mr. Harvey and Dr. Meredith were appointed Auditors for the current year.

The President, Vice-President, Secretary and Treasurer were named delegates to the mining convention to be held on 31st March.

Mr. D. R. Keys, M.A., read on behalf of Mr. A. F. Chamberlain, M.A., fellow in anthropology in Clark University, Worcester, Mass., a paper on "French-Canadian Folk-Lore" The writer called attention to the desirability of further investigation of the folk-lore of the people of European descent resident in the Dominion of Canada. More has been done for Quebec than for Ontario in this respect, the literary men of the former province not being oblivious of the fact that much of the legendary lore of the other France across the sea still lingers in the quiet valleys of Lower Canada. The paper was devoted to the discussion of certain items of folk-lore which are preserved for us in the writings of the French-Canadian novelists and historians, Faucher de Saint Maurice, J. E. Taché, P. A. de Gaspé, P. Lemay, etc. The belief that the "northern lights" can be made to dance by singing or whistling on a calm evening was referred to, and similar beliefs cited as prevalent amongst certain Indian tribes of the North-West. The *feux-follets*, or

Will-o'-the-Wisps, were noticed, and the legends of the "Follet de la Mare aux Bars" and the "Feu de la Baie" were reviewed; reference was also made to the "Feu des Roussis." Attention was called to the widespread belief in goblins and sprites, in which the farfadets, lutins, gobelins, diablotins, etc., of the *habitant* get sometimes very strangely mixed up with the manitous and wendigoes of the red men. A well-known example is the "Phantom of the Rock" that appears every time a member of the family of Frasers is about to die. M. Aunaud Parent, of Oka, chronicles the survival in his younger days of the belief in the werwolf or loup-garou. There are also stories of the appearance of the devil in the form of a large black cat, etc. The beliefs in the *main de gloire* (hand of glory) and in the *chandelle magique* (magic candle) have not yet died out. Particular attention was called to the rural festivals of the French-Canadians, their huskings, bees, and the like. The folk-lore of of these gatherings is very important, and it is desirable that data should be accumulated before these festivals become obsolescent and die out. These festivals and the songs that are sung while they are in progress are valuable for comparison with like customs and songs in old France.

Mr. Geo. Kennedy, LL.D., read, on behalf of Mr. Sandford Fleming C.M.G., a paper on "Reforms in Time Reckoning."

TWENTIETH MEETING.

Twentieth Meeting, 28th March, 1891, the Vice-president in the chair.

Donations and Exchanges, 52.

Prof. W. H. Ellis read a paper on "Milk Analysis." He said that normal milk had a composition about as follows:—

Fat	3·8
Albuminoids	4·0
Milk sugar	4·0
Inorganic salts	0·7
Water	87·5
	100·0

For purposes of detecting adulteration one analysis of milk resolves itself into the determination of the quantity of total solids, of the fat, and the solids other than fat; that is, the sum of the sugar, albuminoids, and inorganic salts which are spoken of together as "solids not fat." The numerous methods of milk analysis in common use of late years

fall into three classes:—(1), Drying the milk in a small dish at the temperature of boiling water, and extracting the fat from this residue by boiling repeatedly with ether. (2), Drying the milk after mixing it with some powder such as sand, sulphate of lime, etc., and extracting the fat from the powdered residue in an extraction apparatus. (3). Sucking up the milk by some absorbent substance such as paper or asbestos, drying in a water-oven, and extracting the dry mass in an extraction apparatus. It has been abundantly shown that all the fat is not extracted by the methods of the first class. The methods of the second class give better results, but those of the third class give the best of all. Of the various processes of the third class the most rapid and convenient, as far as his experience goes, is that devised by Mr. Macfarlane, Dominion chief analyst. This method is at least as accurate as any of the others and deserves general adoption. It consists in absorbing the milk in a short glass tube filled with asbestos, drying to constant weight in a water oven, exhausting in an extraction apparatus with petroleum ether, drying and weighing the residue. In his opinion this plan of weighing the solids not fat, and deducing the fat from the difference between the weight of the total solids and the solids not fat, is preferable to weighing the fat direct. The experiments of Heberes and others, as well as his own, show beyond doubt that the fat gains weight when heated in a water oven. To prevent this change from taking place while the total solids are drying, he has devised an apparatus which was exhibited for drying in a current of hydrogen or coal gas.

TWENTY-FIRST MEETING.

Twenty-first Meeting, 4th April, 1891, the President in the chair.

Donations and Exchanges 57, including specimens of Grape and Gem iron ore, from Ishpeming, Mich., by Mr. M. J. Paterson.

The following resolution passed by the Mining Convention was read:—"That the thanks of this Convention are hereby tendered to the Canadian Institute for having invited the members of this Convention to assemble in Toronto and meet in the Institute to discuss the questions that have been passed on during the last two days in the interests of mining; and this convention believes that the action of the Canadian Institute in this matter, and the adoption of the resolutions that have been passed will be found to greatly advance the interests of the mining community in all parts of this province; and it is further

resolved that a copy of this resolution be transmitted by the Secretary of this Convention to the Secretary of the Canadian Institute."

On motion by Mr. Clark, seconded by Mr. Macdougall, it was resolved,

"That before any further steps be taken to promote the construction of the trunk sewer it is necessary that more definite and precise informatian be obtained regarding the currents in the lake between the mouth of the Humber and the south side of the Island and Victoria Park.

"That the City Council be requested to take a series of float observations for a period of at least three months, extending through the summer and a portion of the fall—say from July to October, with temperature observations of the water at various depths, and readings of the velocity and direction of the wind taken on the lake at the same time the floats are put in ; these floats to be placed in deep water commencing at thirty feet in depth, and extending to sixty feet or even deeper.

"That the co-operation of the Provincial Board of Health and Board of Trade be enlisted, and that a copy of this resolution be sent to each of the boards, and to the City Council ; and that a delegation consisting of Mr. Carpmael, Dr. Canniff, Mr. A. Harvey, and the mover and seconder, be appointed to bring the matter before the above-named corporate bodies."

Mr. James H. Coyne, B.A., was elected a member.

The following amendment to Section IV., Clause 4 of the Regulations, of which due notice had been given, was adopted :—

"Associates must be recommended by two members, who shall certify to their fitness, and all male associates must be under the age of 21 years, and on attaining that age shall cease to be associates, and are thereafter eligible for election as members."

Dr. E. A. Meredith read a paper on "Miss Dix and Her Life Work."

Mr. William Brodie read a paper on "Modern Ornithology." A short sketch was given of the history of ornithology in America from the time of Catesby (1731), mentioning the names of a few of the best known ornithologists—Wilson, Audubon, Baird, Dr. Coues, Ridgeway, and in Canada, Mr. McIlwraith, of Hamilton. Reference was made as to the general character of the work of these men, and the general widening of the field of research. A few of the special lines of investigation now pursued were indicated, such as food and food habits of old and young, migrations, distribution, variation, psychology, and others. The value of collections to students of the science was pointed out, and the necessity for accurate and full labelling of specimens to give them any scientific

value. The procuring by the Canadian Institute of a full collection of specimens of foreign and native species was urged in the interest of the science in Ontario. The decrease in the desire for "stuffed birds" as household ornaments and trimming for ladies' hats was commented on favorably. The careful and just manner in which our bird laws were administered by the Department of Agriculture in the public interest was also spoken of. A plan was submitted for the consideration of the Institute for the promotion and popularizing of the study of scientific ornithology in Ontario by securing the co-operation of many corresponding observers throughout the province, and thus compiling accurate and full statistics of migration, food, nesting habits, relations to agriculture, and all other particulars relating to birds. It was also held that an intimate acquaintance with the life history of birds, as well as other animals, cauld be recommended on moral grounds as inducing habits of mercy and truth.

TWENTY-SECOND MEETING.

Twenty-second Meeting, 11th April, 1891, Mr. Harvey in the Chair.

Donations and Exchadges 102, including 28 publications of the Geological and Natural History Society of Canada, by Mr. Thomas Shortiss.

Mr. Tozo Ohno read a paper on "Japanese Literature." After a short sketch of the early intercourse between Japan and Europe, and of the second opening of the ports by Perry in 1853, Mr. Ohno stated that since the opening of the C. P. R. and of communication between Canada and Japan the latter had become of all Asiatic countries the nearest to the Western world, and in particular a close neighbor to Canada. In 1890 the Japanese established a representative Government, being the first Eastern country to do so, and to-day Japan is the one Asiatic country where the people enjoy the civilization of the nineteenth century. The Japanese language had been said by Max Muller to be "the strangest in the world." An account of the Japanese syllabic alphabet followed, the reader illustrating the various scripts on the blackboard, and giving specimens of the many foreign words that Japanese like English have borrowed from other civilized and uncivilized languages. Like the English language in America, too, Japanese has no dialects. The distinction between the different scripts was briefly stated thus :—The katakana or male character is practical, the hirakana or female is poetical, and the kangi is rhetorical ; that is, the male character is used in speaking of

simple, every-day subjects, the female is used for poetry, and kangi, or Chinese, for the expression of high-flown and magniloquent ideas. In books of poetry mostly the female manner of expression is found. Among the common people the male and female are both understood and in use. In the newspapers, however, all three forms were combined, so also in novels and in general literature other than poetry. The development of Japanese literature was stated to have begun in poetry, under the influence of woman, and the force was still felt very powerfully, especially at the Court of the Mikado. The next period in the history of the literature was that dominated by the Buddhist priests, when history flourished to a remarkable extent, such popular treatises as "The History of the Middle Kingdom" in 125 volumes, being still read by the Japanese school boys. The third stage in the development of Japanese literature was that of the Samurai or Knights, and is characterized by Confucianism in philosophy, and a lighter style of prose. It was the most brilliant period of Japanese literature, and lasted about 200 years. Its decay was followed by the introduction of European learning, which has been so eagerly received by the Japanese, who have translated from English, French and German, and are now beginning to be recognized in the universities of the Continent as the possessors of a literature worthy of being studied for its own sake.

TWENTY-THIRD MEETING.

Twenty-third Meeting, 18th April, 1891, Dr. Kennedy in the chair.

Donations and Exchanges, 64.

Thomas Hodgins, M.A., Q.C., was elected a member.

Rev. Prof. G. M. Wrong read a paper on "The Study of History." The student of history is something of a prophet—a prophet looking backwards, as Schlegel said. To know history is to know not only facts but the deep significance of facts. The historian has nothing to do with praising or blaming; his work is to paint men as they were. Macaulay took Thucydides as his model of a historian. But there is a writer that rivals Thucydides—the writer of the book of Genesis. He gives a vivid moving picture of the people he depicts, of their virtues and vices, and writes scarcely a word of praise or blame. A variety of endowments is necessary to study history well, and scarcely anyone possesses them all. There are moral endowments. Sympathy—to enable us to stand with the men of the past and see as they saw; unselfishness, that we may

justly estimate what runs counter to our own convictions or interests; moral earnestness, that we may see the purpose in the tragedy of history. The spirit of patient research is necessary for the historian; but he must be more than a book-worm. He must be a man who knows men, who feels the pulse of human emotion throb warmly in his veins. Severe thought is necessary for the student of history. He must rise above the Zeit Geist of his own age, and live in that of the age he would depict. Buckle draws up a formidable list of what he must know—Political economy, law, ecclesiastical affairs, physical science, etc. He must have imagination, too, for "narrative is linear, action is solid," and he must fill a dead outline with moving life. We may ask lastly, what has history to tell us of the future? Without doubt the development of man takes place under law. If we could know the whole of the present we should also know the whole of the future. In this sense there is a science of history. But man cannot know all the present, and history deals with the most subtle of phenomena—the will, the affections, etc. The science of education tells us what influences will develop certain characteristics, but history is concerned with the production of these very influences—a much more obscure question. Yet history has something to say regarding the future. The countryman complained that he could not see the city for the houses, and we, too, cannot see the future because we are so closely hemmed in by the present. We must go to the past and study the tendencies that are fully worked out there, and then we can come back to the present and plan wisely for the future. Lord Chesterfield, a keen man of the world, who had studied history, predicted the French Revolution a quarter of a century before it came. The future is not determined, any more than a people's language is determined, by theories. A wise, wide study of facts and induction based upon these is the only foundation of historical prophecy. A thread of purpose runs through the ages, and, as Mr. Goldwin Smith has said, theistic belief is the only thing that can preserve us from despair.

On behalf of Mr. Wm. Houston, a paper on the "Genesis and Growth of Capital," was read by Mr. Alan Macdougall, C.E., in which the following statements were made:—One of the most important features of the economic condition of the world, and especially of America, at the present day is the accumulation of large masses of wealth in the hands of individuals. Millionaires abound in the United States, and not a few men are reputed to be worth a great many millions each. These men do not let their wealth lie idle. If "capital" is rightly defined to be that portion of wealth which is devoted to the production of more wealth, then practically the whole of each man's wealth is "capital." It is not the purpose of this paper to trace the effect of such aggregations of

capital on the industrial and commercial conditions of society; its aim is to enquire how such fortunes have been accumulated, and, assuming that a more equable distribution of wealth would be an improvement, to point out how this can be effected. "Capital," using the term in the sense assigned to it above, is the result of the operation of some general principle or law in economics. There is nothing like unanimity amongst economists as to either its origin or its nature. The older economists generally concurred in attributing its existence to "abstinence" or "saving." This was the view of Smith, Senior, and Mill. To some extent it accounts for the existence of "capital," but it does not account for the massing of it in large quantities in few hands. Men like Jay Gould, Vanderbilt, Huntington, or Rockefeller do not "save" to any appreciable extent. They spend on themselves as much as they can personally consume, and indulge in luxuries of the most costly kind, and yet their wealth goes on increasing with enormous rapidity. As that wealth is employed in production it is practically all capital, for each of these men is an active producer. Something more than mere abstinence is necessary to explain the accumulations of capital. Karl Marx endeavours to explain the phenomenon by what is called the "surplus-value" theory. Every commodity when produced has either use-value or exchange-value, or both. Use-value depends on the value of the raw material and the value of the labour expended on it, and the commodity ought to equal in value the sum of these two values. But it ordinarily exchanges for more than this, and this additional amount is called "surplus value" (German "*Mehrwerth*"). The conditions of capitalist production, with which all are familiar, enable the capitalist to appropriate this surplus value without sharing it with the labourer, who is reduced by the iron law of competition in wages to working for bare life. Without going into the ingenious analysis of Marx in detail, it is sufficient to admit here that it has shed valuable light on the source from which masses of capital are drawn and the processes by which they are collected. All this, however, does not yet explain the phenomenon of the enormous fortunes made by individuals in our own day, so much more frequently than they were made a few years or a generation ago. It is alleged of some great capitalists that they make money by dishonest devices, such, *e. g.*, as depreciating the shares of a railway, buying them up, and then appreciating them—restoring to them their original value or more. This practice may, probably does, explain some of the cases, but not all. The enormous accumulations spoken of seem to be due chiefly to two causes: (1), Monopoly of opportunity, and (2), the law of inheritance. Given a limited range of opportunity to produce some article that is in general demand, with the control of this oppor-

tunity by one man, and he must accumulate wealth whether he desires to do so or not. The supply of petroleum in the United States is controlled by the Standard Oil Company, which owns many of the wells and can dictate terms of distribution of the product of many others. The Standard Oil Company, therefore, are in a position to levy a toll on all the oil that goes into use, and even a moderate toll soon accumulates. This is the main source of Mr. Rockefeller's wealth, though since he has been placed in so advantageous a position he makes money rapidly in other ways also. Money accumulated by one man in his lifetime would not remain long in one man's hands after his death if it were not that he is able before he dies to say how it shall be disposed of. Cornelius Vanderbilt left the bulk of his wealth to his son, and his son left it to his grandson, who is now one of the most wealthy of the millionaires. But for this power of *post-mortem* conveyance each mass of accumulated wealth would soon disolve and pass into a number of hands, instead of being controlled by one. That in the main it is economically desirable to avoid extremes in the matter of wealth is quite certain. The sociological conditions of the community are improved by having a large number of moderately wealthy persons rather than by having a few enormously wealthy in the midst of a mass of poor people. If great accumulations of wealth are due chiefly to monopoly of opportunity and to *post-mortem* control of accumulations, it is obvious the remedy must be two-fold. The monopoly must be broken up and the succession to property must be regulated. The former can best be secured by the single tax on opportunity, and the latter by the succession tax on bequests or inheritance. If the Standard Oil Company were forced to pay over a large share of their monopolistic gains to the community in reduction of, or substitution for, other taxation, Mr. Rockefeller would never have possessed so much wealth. If the younger Vanderbilts had each in succession been required to pay a heavy succession tax each would have been just as well off in all important respects as he is now, and the community would have been better off than it is now, or might have been. It is not necessary here to defend the principle of either a monopoly tax or a succession tax. In my opinion each is defensible on the ground of justice, and also on the ground of expediency. My object is simply to call attention to the relation which these two forms of taxation bear to the great economic questions which grow out of the accumulation of capital in the hands of a few individuals, leaving millions of others the poorer for their wealth.

TWENTH-FOURTH MEETING.

Twenty-fourth Meeting, 25th April, 1891, Mr. Harvey in the chair.

Donations and Exchanges, 60.

Mr. Morley Parker was elected a member.

Nominations for officers for the ensuing year were made.

The Secretary read the report of Mr. Arthur Harvey, who had represented the Institute at the Jamaica Exhibition.

A paper by Rev. Dr. MacNish on "A Gaelic Cuneiform Inscription" was read by Dr. Kennedy.

Mr. J. Castell Hopkins read a paper on "British and Canadian Trade Relations."

Mr. William Brodie read a paper on "Intelligence of Insects as Exemplified by Pelopœus Cementarius."

Mr. W. Knox exhibited and explained plans for certain proposed additions to the Institute building.

FORTY-SECOND ANNUAL MEETING.

Forty-second Annual Meeting, 2nd May, 1891, Dr. E. A. Meredith in the chair.

Donations and Exchanges, 59.

The Forty-second Annual Report and the Reports of Sections were read, received and adopted on motion by Mr. Macdougall, seconded by Dr. Canniff.

On motion by Mr. Pursey, seconded by Mr. Elvins, it was resolved—

"That the thanks of the Institute be tendered to the press, and particularly to the *Mail* for the full reports of the proceedings of the Institute.

The election of officers for the ensuing year resulted as follows :—

President—Arthur Harvey, Esq.

Vice-President—James H. Pearce, Esq.

Secretary—Alan Macdougal, M. Inst. C.E.

Treasurer—James Bain, Jr., Esq.

Librarian—D. R. Keys, M.A.

Curator—David Boyle, Ph.B.
Editor—George Kennedy, M.A., LL.D.
Members of Council—A. B. Macallum, Ph.D.
W. H. Ellis, M.A., M.B.
B. E. Walker, Esq.
C. Carpmael, M.A.
William Brodie, Esq.

FORTY-FIRST ANNUAL REPORT.

The Council of the Canadian Institute has the honor to lay before its members its Forty-first Annual Report.

The work of the Institute has been well maintained during the year. An increased interest and impetus to original research have been imparted through the visit of the American Association for the Advancement of Science.

The Council takes much pleasure in reporting that the visit of the above-named society to this city, between the 27th August and the 3rd September, 1889, was most successful; there was a large attendance of members, 421 being present, and it was remarked as a rare occurrence, that there were so many ex-presidents present. Out of 62 new Canadian members, 35 were members of the Institute. The number of papers contributed by Canadians was large, the members of the Institute contributing their full proportion.

The Council desires to express its hearty thanks to the several bodies who gave up the use of their buildings, to the Press for the close attention given to the meetings and the very extensive reports of them, and to the ladies and gentlemen, who, through their kind hospitality, aided so much in the social part of the meetings.

The interest in the movement for the introduction of cosmic time is well-maintained, and is increasing. The American Society of Civil Engineers has issued several valuable reports detailing its extension on this continent and in other countries; over 230 railway companies in North America use this system; the Kingdom of Prussia has adopted it, and it is being introduced into Austria. Dr. Robert Schram, of Vienna, and Prof. Pasquier, of Louvain, have been directly instrumental to much of its extension in Europe. Petitions from the Institute have been presented to His Excellency the Governor-General, the House of Commons,

the Senate, His Honor the Lieutenant-Governor, and the Legislative Assembly of the Province of Ontario, praying for the legalizing of this mode of time reckoning. A bill has been read for the first time in the Senate, entitled " An Act respecting the Reckoning of Time."

The thanks of the Institute are due to Dr. Fleming for his unremitting interest in this subject.

The Council deplores the destruction of our Provincial University by fire ; a resolution of sympathy has been sent to the Senate and College Council.

The meetings continue to be well attended ; there were 21 ordinary meetings, at which 30 papers were read, and 36 meetings of the several sections, at which 32 papers were read.

The Council again acknowledges its thankfulness to the generosity of the Provincial Government, for once more placing the sum of $1,000 at the disposal of the Institute for archæological research. Many of the cases have been re-arranged to facilitate the study of the specimens, and the history thereby imparted. A very full descriptive catalogue has been compiled and appended to the valuable report prepared by the Curator and published as an appendix to the report of the Honorable the Minister of Education.

The museum was visited by a large number of leading American archæologists, who were very much pleased with the collection, and surprised at the result arrived at by such a moderate expenditure of money.

The Institute has received invitations from the Towns of Orillia, Barrie, and Niagara, and the Chautauqua Company of Niagara, to hold a summer convention in each town. The Council has accepted that of the Town of Niagara, and preparations are being made for holding a meeting there.

Increased shelving is being put up in the library ; this will permit the books to be better arranged and classified, and more readily accessible to members. There is urgent need of a fund for binding purposes. Valuable additions are being made constantly, and the destruction of the university library makes ours of greater increasing value as a library of reference.

The Treasurer's statement shows a satisfactory balance at the credit of the Institute.

The membership has been increased during the year by 26 elections, of whom 18 have fulfilled the conditions and become active members. The policy entered upon last year of enforcing the regulations regarding

arrears has been carried out this year; there are now very few members in default.

The Council expresses its deepest regret for the loss sustained by the Institute in the sudden death of Mr. Alexander Marling, LL.B., who was a member of Council, and one of our most highly esteemed members.

In the death of General Sir J. H. Lefroy, F.R.S., K.C.B., etc., the Institute has lost one of its earliest presidents, and a member whose distinguished career has been an honor and gain to his country and the cause of science.

We have also to record the death of Mr. John Notman, who always took a deep interest in the welfare of the Institute, was a valuable member of Council, and was the treasurer for ten years, during which period the present building was erected; and of Mr. Samuel Keefer, also one of our earliest members, an engineer of high standing, who was elected the second president of the Canadian Society of Civil Engineers.

The reports of the various sections are appended.

All of which is respectfully submitted.

CHARLES CARPMAEL,

TORONTO, 3rd May, 1890. *President.*

APPENDIX I.

MEMBERSHIP.

Number of Members, 1st April, 1890:—

Honorary Members	8	
Life Members	12	
		20

Ordinary Members:—

1. Who have paid their subscriptions to 31st December, 1890, including new members	125	
2. Who have paid their subscriptions to 31st Dec., 1889	62	
3. " " " 31st Dec., 1888	26	
4. Who are two years and more in arrears	20	
		233
Total, 1st April, 1890		253

5. Losses through death and withdrawals	10	
6. Struck off	4	
7. Suspense	2	
		16
8. Members elected during the present session who have paid their first annual subscription	18	
9. Who have not yet paid	9	
		27
Associates, 1st April, 1889	32	
1. Who have paid to 31st December, 1890	14	
2. " " 31st December, 1889	20	
3. " " 31st December, 1888	3	
4. Two years in arrears	3	
		40
Elected during the session	5	
		5

APPENDIX II.

FINANCIAL STATEMENT.

The Treasurer in account with the Canadian Institute for the year ending March 31st, 1890.

To Summary.

To Balance in Imperial Bank	$ 137 00
" Cash in hand	38 07
" Annual subscriptions	706 00
" Life memberships	100 00
" Rents	166 00
" Government grant	1,000 00
" Periodicals sold	46 66
" Journals sold	9 41
" Interest on deposits	9 68
" Refunded from Archæological Grant	42 08
" Building Fund (Insurance)	244 00
	$2,498 90

By Summary.

By Salaries	$413 00
" Printing (proceedings)	641 13
" " (miscellaneous)	33 75
" Stationery	33 01
" Postage	161 46
" Freight and express charges	11 19
" Repairs	49 53
" Gas	44 31
" Water	7 30
" Periodicals	73 04
" Furniture	174 78
" House cleaning	68 10
" Fuel	27 00
" Taxes	9 66
" Advertising	5 50
" Binding	178 65
" Type writing	11 40
" Bird stuffing	21 10
" Chemicals	4 32
" Valuator's fees	25 00
" Archæological grant	30 00
" Interest	200 00
" Balance in Imperial Bank	270 45
" Cash in hand	5 22
	$2,498 90

ASSETS AND LIABILITIES.

ASSETS.

Building and ground	$18,000 00
Library	5,000 00
Specimens	3,000 00
Personal Property	1,000 00
	$27,000 00

LIABILITIES.

Mortgage No. 1, due 1892	$ 3,000 00

Mortgage No. 2, due 1892	1,000 00
Balance in favor of the Institute	23,000 00
	$27,000 00

Examined and found correct, April 15th, 1890.

(Signed) ARTHUR HARVEY, W. E. MIDDLETON, *Auditors.*

James Bain, Jr., in account with Archæological Grant.

1889.	To Balance from last year	$ 5 25
May 27.	Government Grant	1,000 00
		$ 1,005 25
1889.		
May 27.	By David Boyle on account expenses	$ 100 00
" 28.	" R. W. Young, sundry expenses	11 63
" 28.	" C. J. D. Rutzer, specimens	25 00
June 29.	" David Boyle, on account salary	100 00
July 24.	" C. W. Riggs, Cincinnati	100 25
" 30.	" David Boyle, salary	100 00
Aug. 17.	" John B. Baker	94 08
Sept. 5.	" David Boyle, salary	100 00
" 28.	" David Boyle on account expenses	100 00
Dec. 2.	" John Notman, specimens	10 00
" 19.	" David Boyle, salary, extra vote	100 00
1890.		
Mar. 28.	" Toronto Engraving Co	54 75
Apr. 11.	" Father Laboureau, specimens	10 25
" 24.	" J. B. Baker, case	93 86
	" Balance in Bank	5 43
		$1,005 25

By Summary.

1889	By Purchase of specimens	$ 166 12
	" Travelling and working expenses	112 25
	" Salary of Curator	400 00
	" Express charges, postage, and sundries	63 56
	" Cases	187 94
	" Engraving	54 75

" Balance in hands of Curator	15 20
" Balance in Bank	5 43
	$1,005 25

Certified correct, 24th April, 1890.

(Signed) ARTHUR HARVEY, } *Auditors.*
W. E. MIDDLETON, }

TORONTO, April 15th, 1890.

The Auditors having examined the accounts and vouchers, which, as usual, are in perfect order, beg to report:—That the distribution of the various items of revenue and expenditure made by the Treasurer corresponds with the cash accounts kept by Mr. Young. We have also checked the Bank book.

The Auditors' recommendation of last year, to have the various assets of the Institute valued, has been carried out as respects the building and ground, and it appears that the whole property is more valuable than previous balance sheets disclosed. We have had an entry made which shows approximately the true present value of the property.

We do not see that any report has been made as to the value of the library and museum. Though it is difficult to appraise these assets, we think an attempt should be made.

ARTHUR HARVEY, } *Auditors.*
W. E. MIDDLETON, }

APPENDIX III.

PAPERS READ SESSION, 1889-90.

1889, Nov. 2. "Pelotechthen Balanoides,"—Arthur Harvey, Esq.
"Prison Reform in the United States,"—Dr. A. M. Rosebrugh.
" " 9. "French Relics from Village Sites of the Hurons,"—A. F. Hunter, B. A.
" " 16. "City Sanitation and the Sewage Problem,"—L. J. Clark, Esq.
" " 30. "Scientific Time Reckoning,"—Sandford Fleming, C.M. G., LL.D.
" Dec. 7. "The Canadian Indian Research and Aid Society."—Rev. E. F. Wilson.
" " 14. "The Cruel Plant (Physianthus Albens),"—Arthur Harvey, Esq.
"Birds recently added to the Museum,"—J. B. Williams, Esq.

1889, Dec. 21. "Codification of the Law,"—T. B. Browning, M.A.
1890. Jan. 11. "Personal Experiences in Haiti under President Lègitime,"—Chas. G. Y. King, Esq.
" " 18. "Distribution of Wealth as related to Production,"—W. A. Douglass, B.A.
" " 25. "The Indians of Canada,"—A. F. Chamberlain, M.A.
" Feb. 1. "The Maroons of Jamaica and Nova Scotia,"—J. C. Hamilton, LL.B.
" " 8. "The Edison System of Electric Light,"—J. F. Cummings, Esq.
" " 15. "Sun Spots during 1889,"—A. Elvins, Esq.
" " 22. "Color in Nature."—W. A. Sherwood, Esq.
" Mar. 1. "Natural History of Drinking Waters,"—P. H. Bryce, M.A., M.D.
" " 8. "Canadian Faunal Lists,"—E. E. Thompson, Esq.
" " 22. "Defective Vision in the Public Schools,"—Dr. G. S. Ryerson.
" " 29. "Ossianic Poetry,"—David Spence, Esq.
"Preliminary List of Algae,"—J. J. MacKenzie, B A.
" April 5. "Meteorological Conditions during the past Winter,"—R. F. Stupart, Esq.
" " 12. "The American Indian in Literature,"—A. F. Chamberlain, M.A.
" " 19. "Gleanings from European Art Fields,"—J. W. L. Forster, Esq.
"The Dènè Languages,"—Rev. A. G. Morice.
"Codification of The Law (Real and Personal Property)," T. B. Browning, M.A.
" " 25. "Present Efficiency in Sewage Disposal,"—Alan Macdougall, C.E.
"Formation of Toronto Island,"—L. J. Clark, Esq.

Classification of papers by subjects :—

Anthropology	3	Philology	2
Archæology	1	Physics	2
Astronomy	2	Physiology	1
Botany	3	Sanitary Science	3
Economics	1	Social Science	1
Fine Arts	1	Sociology	1
Geology	1	Voyages and Travels	1
Jurisprudence	2	Zoology	2
Literature	2		—
Meteorology	1	Total	30

Read at meetings of Sections :—

Biological Section	20
Geological "	6
Historical "	2
Philological "	4
Total	32

REPORT OF THE BIOLOGICAL SECTION.

TORONTO, April, 1890.

This Section has to report favorable progress during the past session, and is at present in thorough working order.

The Museum is gradually increasing. We have received from the Institute a cabinet for ornithological specimens, costing nearly $100, and two table cases for miscellaneous specimens. The Council of the Institute also voted the Section $100 for biological purposes, and a considerable number of bird skins have been mounted through this grant. Field-day excursions were organized during the summer with more success than in preceding years, and we have good hopes for the coming season in this department on account of the forming of the sub-sections.

The ornithological sub-section which was organized on Dec. 21, 1888, has compiled its first report, which will appear in due course in the Proceedings of the Institute. The report will no doubt be well received and appreciated, as it gives particulars of work done, that would do credit to a much older society, and which the ornithological sub-section may well be proud of.

A mammalogical sub-section has lately been formed, also a botanical sub-section, under Mr. Hollingworth, which promises well.

"Gossip meetings" have been held at the President's residence, 226 Beverley street, once a month, where some pleasant and useful evenings were spent.

The number of papers show a slight decrease from last year, but we expect they will be largely increased during the coming session.

A schedule showing the papers read is attached.

The officers for the coming session are :—James H. Pearce, *Chairman*; William E. Middleton, *Secretary*.

CHARLES W. ARMSTRONG,
Assistant-Secretary.

List of Donations and Additions to the Natural History Department of the Museum during the past year :—

5 Mounted specimens of Polypoid Animals of the Pacific.	*Donor*—W. B. Wright, Los Angeles, Cal.
Specimen of Cruel plant 1 Evening Grosbeak	*Donor*—Arthur Harvey, Rosedale.
2 Hairy Woodpeckers 1 Arctic Three-toed Woodpecker 1 Yellow-bellied Sapsucker 2 Redpolls 1 Juncos	*Donor*—W. P. Melville, Muskoka.
3 Specimens, English Rabbit 2 Specimens, American Rabbit	*Donor*—E. E. Thompson, Toronto.
Collection of Mounted Specimens of English Plants.	*Donor*—W. Knox, Toronto.

The following mounted specimens have also been added to the collection ; most of them have been procured in the neighborhood of Toronto, by members of the Biological Section :—

Bonaparte's Gull,
Caspian Fern,
Stilt Sandpiper,
Red-backed Sandpiper,
2 Yellow-billed Cuckoo,
Black-billed Cuckoo,
Red-headed Wookpecker,
2 Belted Kingfisher,
Rough-legged Hawk,
2 Least Bittern, with nest and eggs,
Crested Flycatcher,
Olive-sided Flycatcher,
Yellow-bellied Flycatcher,
Wood Pewee, with nest and eggs,
Cowbird,
2 Red-winged Blackbird,
Song Sparrow,
Tree Sparrow,
Indigo Bunting,
Fox Sparrow,
Redpoll,
Pine Siskin,
2 Pine Grosbeak,
2 Evening Grosbeak,
Horned Lark,
Scarlet Tanager,
Cedar Waxwing,
House Wren.
Winter Wren.
Long-billed Marsh Wren,
Catbird,
Myrtle Warbler,
Chestnut-sided Warbler,
American Robin.

J. B. WILLIAMS,
Natural History Curator.

SCHEDULE OF PAPERS.

1. James H. Pearce .....*Chrysanthemum Cinerariæfolium.*
2. W. E. Middleton .....*Some Low Forms of Life.*
3. Wm. Brodie .....*Clays exposed by Don Cuttings.*
4. An evening spent in the museum by the members.
5. Geo. Atkinson .....*Report of the Ornithological Sub-Section.*
6. James H. Pearce .....*President's Report.*
7. C. Armstrong .....*Physianthus Albens.*
8. An evening spent in the museum by the members.
9. W. E. Middleton .....*Pollen.*
10. C. Armstrong .....*Pollen.*
11. J. B. Williams .....*Abstracts from Ornithological Report.*
12. Wm. Cross .....*Rare Birds.*
13. W. E. Middleton .....*Algæ.*
14. Ernest E. Thompson .....*Rare Birds in University.*
15. Wm. Brodie .....*The Zoology of Indian Mounds.*
16. James Thurston .....*Notes on the Mammoth.*
17. Geo. Atkinson .....*Notes on Ontario Birds.*
18. C. W. Nash .....*Food of Birds.*
19. J. J. McKenzie, B.A. .....*Bacteria.*
20. Geo. Atkinson .....*Notes on Ontario Birds (Continued).*

REPORT OF THE GEOLOGICAL AND MINING SECTION.

Toronto, April 22nd, 1890.

The Geological and Mining Section has the honor to report that the past session has been a very interesting and instructive one to those who have followed the various papers and the discussions thereof.

The subjects treated of have been :—

"The Copper and Nickel Deposits of Sudbury," Dr. Richardson.

"The Coals of Western Canada," W. H. Merritt, F.G.S.

"Arsenic and Sulphur as Metallurgical Agents in the Treatment of Canadian Argentiferous and Auriferous Ores," R. Dewar.

"The Physical Phenomena of Underground Water," P. H. Bryce, M.D.

"On Boulders," Arthur Harvey. (To be read on the 24th instant.)

In addition to these a most interesting paper was read by Prof. J. W. Spencer, State Geologist of Georgia, on "The Building of the Great Lakes."

This paper the Secretary was desirous to secure for publication in the Proceedings, but Prof. Spencer was reluctant to allow the proof-reading to escape his supervision. As the paper is an important and original contribution to the geological speculations on the origin of the lakes, it is to be hoped that on Prof. Spencer's return from Europe the Institute may have the honor of publishing it. Prof. Spencer is a Canadian, whose earliest geological studies were carried on in this neighborhood, and it was with peculiar pleasure that he introduced his completed study of the problem of the lakes to a Canadian scientific body.

The museum of the Institute has been enriched with some valuable specimens, and when more room can be given, the Section is ready to devote time and attention to this important branch of its enjoyable duties.

ARTHUR HARVEY,
Vice-Chairman.

REPORT OF THE PHILOLOGICAL SECTION.

TORONTO, April 15th, 1890.

In accordance with the Constitution of the Institute, I beg to submit the following as the Report of the Philological Section for the year 1889-1890. A programme for the Session was arranged as follows :—

1889.	Nov.	12.	"The Study of Gaelic."
"	"	26.	"The Study of Modern Languages in Canadian Universities." A historical sketch, by D. R. Keys, M.A.
"	Dec.	10.	"The Study of Gaelic."
"	"	24.	"Jargons and Mixed Languages, I." By A. F. Chamberlain, M.A.
1890.	Jan.	14.	"The Study of Gaelic."
"	"	28.	"Jargons and Mixed Languages, II." By A. F. Chamberlain, M.A.
"	Feb.	11.	"The Study of Gaelic."
"	"	25.	"Scandinavian Influence upon Contemporary English Literature." By D. R. Keys, M.A.
"	Mar.	11.	"The Study of Gaelic."
"	"	25.	"German words in English." By A. F. Chamberlain, M.A.
"	April	9.	"The Study of Gaelic."

The first half only of this programme has been carried out, and I regret to say that it does not seem possible, in the present circumstances, to go on with the work of the Section. The formation of the new Historical

Section will, no doubt, enable some of the members to lay before it the results of their investigations on lines in which Language, Anthropology, and History converge. It is to be hoped that no very long period will elapse before it may be possible to successfully maintain a Philological Section of the Institute.

A. F. CHAMBERLAIN,
Secretary.

REPORT OF THE HISTORICAL SECTION.

TORONTO, April 22nd, 1890.

The Historical Section was formed on the 15th February last, for the study of the history of Canada and cognate subjects, such as Archæology, Genealogy and Ethnography, the officers being :—James Cleland Hamilton, LL.B., *Chairman;* D. A. O'Sullivan, LL.D., Wm. Houston, M.A., Geo. M. Rae, Esq., *Committee;* Arthur Harvey, *Secretary (pro tem.)*

It has held two monthly meetings, at each of which a paper of much interest was read. Mr. Houston favored the Section with a *resumé* of a forthcoming work, his subject being, "The Genesis and Development of Legislative Functions in the Northern Parts of America." Mr. J. G. Ridout read an account written by the late Hon. Thomas Ridout, Surveyor-General of Canada, of his captivity among the Shawnees in 1788. This narrative will also be soon made public property in a volume written by Mrs. J. D. Edgar. Several papers upon subjects of deep historical interest are promised for next session, and it is possible that fortnightly meetings may be necessary so that full opportunities may be given for their discussion.

A resolution was passed at the last meeting enabling the officers of the Section to take part in preparing for the approaching celebration of the centenary of this Province. The attention of the Council is called to the subject, as the officers would prefer that the Institute as a whole should take an interest in the commemoration.

The Section will in due time bring before the Council its views respecting the providing of cases for the collection of coins and medals now in the Institute's possession, and of safes for the valuable MSS. with which it may be entrusted.

J. C. HAMILTON,
Chairman.

REPORT OF THE LIBRARIAN.

TORONTO, April 15th, 1890.

Since my election as Librarian in May of last year, I have devoted what time I could reasonably spare to an examination of the books in the library, with a view to their proper arrangement and classification. The lack of shelf space has hindered systematic arrangement, but a short time ago it was wisely determined by the Council to provide new shelving for some 1,500 volumes, and with this increased accommodation it is to be hoped that the books will be so arranged during the coming summer as to admit of ready consultation.

The value of the series of scientific societies' proceedings, transactions, etc., now in the Institute's library is very great, and such value must tend to increase. The total number of exchanges received by the Institute for the year (April 1st, 1889, to April 1st, 1890) is 485, consisting of 2,402 separate volumes and fasciculi. For facility of reference these exchanges must be bound, and it is evident that the Institute, in having them all bound as soon as possible, would only be doing what is clearly to the advantage of its members and of students of science in all its branches. I therefore have no hesitation in recommending and requesting that a certain fixed sum be appropriated annually towards the binding of volumes in the library.

The exchange list of the Institute's Proceedings is yearly increasing, and the widened circulation given to the papers read before it must result in benefit to the Institute in general and to the individual authors.

I cannot refrain from congratulating the Institute upon the great value of its library to men of science throughout Canada, for the volumes it contains excited in no small degree the admiration of the American friends who were our guests and visitors in August last. I hope the time is not far distant when there will be few scientific libraries in America that will exceed in value and importance that of our own Institute.

Finally, I beg to recommend that some steps be taken towards securing the proper cataloguing of the library, and disposing of such miscellaneous books as it is not desirable to retain in a purely scientific library. It will also be necessary to provide for the proper safe-keeping (should the Institute not see fit to dispose of them) of the many valuable pamphlets now in the possession of the Institute.

Annexed will be found the usual statement of the accessions to the

library during the year (April 1st, 1889, to April 1st, 1890), and other information connected therewith :—

STATEMENT.

I.	Donations to the Library	191
II.	Exchanges :	
	1. Canada	154
	2. United States	668
	3. Mexico and South America	53
	4. Great Britain and Ireland	501
	5. Austria-Hungary	164
	6. Belgium	17
	7. Denmark	6
	8. France	326
	9. Germany	134
	10. Italy	124
	11. Netherlands	35
	12. Norway	9
	13. Portugal	10
	14. Roumania	1
	15. Russia	38
	16. Spain	24
	17. Sweden	47
	18. Switzerland	9
	19. British India	19
	20. Java	21
	21. China	4
	22. Japan	8
	23. Cochin-China	1
	24. Africa	7
	25. Australasia	22
	Total separate numbers and volumes	2,402
III.	New exchanges added during the year	56
	Exchanges discontinued during the year	6
	Increase during the year	50
IV.	Total number of exchanges	485
V.	To the Periodicals subscribed for last year have been added : "The New Review," "Scribner's Monthly," "The Bystander," "The Photographic Societies' Reporter,"	

and "The Photographic Quarterly," making a total of 36

The total number of separate numbers received 778

VI. The number of books and periodicals taken out from the library and reading room during the year 1,622

A. F. CHAMBERLAIN,
Librarian.

REPORT OF THE SOCIOLOGICAL COMMITTEE.

TORONTO, May 3rd, 1890.

The Sociological Committee begs leave to submit to the Council its report for the year 1889-90.

1. Your Committee enlarged its circular of last year so as to include matters of philological import and distributed about 1,000 copies of it throughout the Dominion. The enlarged circular is printed in the last fasciculus.

2. Your Committee was allotted twenty-five dollars ($25.00) for its expenses of printing, postage, etc. The accounts have been audited by the auditors and show a balance in the Institute's hands of four dollars and twenty-five cents ($4.25). About five hundred (500) circulars are yet undistributed.

3. Your Committee submits to the Council the following papers read before the Institute by title :—

(1) The Dené Languages considered in themselves and in their relations to the principal linguistic groups, by the Rev. Father Morice, O.M.I.

(2) The Philology of the Cree Language, by the Rev. E. B. Glass, B.A.

(3) The Cree Indians sociologically considered, by the Rev. Father Végréville, O.M.I.

And recommends their publication in the Proceedings.

4. Your Committee takes much pleasure in again expressing its indebtedness to the press at home and abroad.

5. Last year your Committee had the pleasure of reporting that the Honorable the Superintendent-General of Indian Affairs, at the instance

of your Committee, had undertaken to have copied and printed, all Indian treaties in his Department now or formerly in force, which affect any portion of the Dominion and yet remain unpublished. Annexed to this report will be found a letter from the Deputy Superintendent-General, written in reply to an enquiry by your Committee as to the completion of the work.

6. Your Committee has much pleasure also in acknowledging receipt from the Superintendent-General of Indian Affairs of a copy of all reports on Indian affairs made to his Department since the inception of the Dominion (1867-89) and requests that the same be placed in the library for the purpose of reference.

T. B. BROWNING,
Chairman.

OTTAWA, 21st April, 1890.

SIR,—I am directed by the Superintendent-General of Indian Affairs to inform you, in reply to your enquiry of the 17th instant, that the work of copying the treaties is much greater than was anticipated, and is not yet nearly completed. When the copying is done, the MSS. will be put in the hands of the printer; but the completion of the work cannot be expected for some time.

I have the honor to be, Sir,
Your obedient servant,
R. SINCLAIR,
For Dep. Supt.-Gen. Indian Affairs.

T. B. BROWNING, Toronto, Ont.,
Chairman Sociological Committee, Canadian Institute.

FORTY-SECOND ANNUAL REPORT.

The Council of the Canadian Institute has the honor to lay before its members its Forty-second Annual Report.

The Council has again the pleasure of recording an increased interest in the work, and a continued extension in the influence of the Institute.

The great work in which we are deeply interested, the adoption in

every part of the world of the use of cosmic time, has received much attention and consideration from the Council and Institute. The movement has made marked progress during the past year. The use of this system of marking time has been adopted by the Governments of many countries, from Germany to Japan.

The circulars of Lord Knutsford, of dates 26th July and 21st Nov., 1890, being addressed only to the Colonies and dependencies of the British Empire, your Council, observing this, directed the attention of His Excellency the Governor-General to this fact, and respectfully suggested that he should direct the attention of foreign Governments to this important movement, which he agreed to do.

Two years ago, when the Royal Commission on Mines was formed, Mr. Hamilton Merritt, F.G.S., chairman of our Geological Section, was placed upon it. A most interesting and valuable report was issued last summer. Recognizing the value of the work done by the Commission, the Institute, on the petition of the Geological Section, called a Mining Convention to be held here on the 31st March, which was held on that day and the two succeeding days. The Convention was largely attended, nearly all the leading miners and persons interested in mining matters in the Province being present. The resolutions submitted through our Section on the establishment of a Provincial Mineralogical Museum; the establishment of a properly equipped school of mines, and the appointment of a departmental head for mining matters, were all adopted by the Convention. Before the convention broke up, a deputation had several interviews with the Government, which have led to the enactment of legislation which will have direct and practical bearing on the future of our mining development.

The Biological or Natural History Section, with its sub-sections in Microscopy, Ornithology and Botany, has added considerably to our museum, as well as encouraging largely an interest in all these important branches among many of our young men in the city.

The Historical Section, formed on the 15th Feb., 1890, for "the study and investigation of the history of Canada and cognate subjects, such as Archæology, Genealogy and Ethnology," has been most active in promoting the objects for which it was formed.

At an interview with the Government the Hon. Atty.-General Mowat requested the deputation to forward a memorandum in writing of such documents as they thought should receive consideration. A memorial on "Historical documents deserving the attention of the Administration of the Province of Ontario, with a view to their publication," was for-

warded on the 15th Feb., 1891. The memorial also prayed that special enquiry be made for the loan of documents relating to early family history, now in private possession, with a view to their being copied; and a collection formed of interesting relics of pioneer life for a Provincial museum.

A memorial was also presented to the Hon. Minister of the Interior, on the same date, requesting the Dominion Government to aid the Institute in "research into the various subjects connected with the early Indian occupation of the Dominion." The Council regrets to say an unfavorable reply was received to this petition.

The invitation of the town of Niagara to the Institute to hold its first summer convention in that charming old historic centre was readily accepted. A well attended convention was held there on the 2nd and 3rd July, 1890. Several papers were read by the residents which added greatly to the interest of the meeting. The Council cannot refrain from expressing its pleasure and acknowledging its thanks for the excellent paper contributed by Miss Carnochan on "Two Frontier Churches."

The Archæological branch of our work suffers no loss. The curator, indefatigable as ever, has again enriched the museum and saved to the Province a large collection of relics, which will ere long be of inestimable value to the students of anthropology, ethnology, archæology and sociology. Special mention may be made of the Geo. C. Laidlaw loan collection of stone, earthenware, and other specimens obtained in neighborhood of Balsam Lake; a collection lent by Dr. Tweedale, from Elgin County; and the Long collection of bone ornaments and implements collected near Toronto, first loaned by Mr. Long and now the property of the Institute by purchase.

The Annual Report of the Curator this year, a work surpassing in interest any of his former reports, has been distributed among the members. The Council commends it to the careful study of every member interested in the history of our Province.

The Institute was ably represented at the Congress of Romance Languages, held in Montpelier, France, 26th May, 1890, by Mr. Arthur Harvey, and in February of this year he presented his credentials to the Institute of Jamaica, during the time of the Exhibition. His reports from both places are full of interest.

The Council takes pleasure in acknowledging once more the generosity of the Ontario Government in placing the sum of $1,000 at its disposal for the extension of archæological research, and for assistance in printing the report on archæology.

Dr. Sandford Fleming, on learning that he could not at present pay over the capital sum of his policy of life insurance made out in favor of the Institute, has generously resolved to pay the interest thereon, amounting to $200 per annum, during his life time.

A large number of donations to the library and museum have been received. A valuable and scarce book, "The Nests and Eggs of the Birds of Ohio," presented to the Institute through the Biological Section by the Rev. Vincent Clementi, of Peterboro', Ont.

A fine specimen of Haida Indian wood carving from Queen Charlotte Island group, through Mr. J. F. Jones, of Vancouver, B.C. The Laidlaw and Tweedale loan collections, and gifts to the archæological museum from Messrs. Cyrenius Bearss, W. and D. Melville, A. Robertson, of Madoc ; A. Crawford, of King ; H. F. Switzer, of Midland City ; T. A. Beeman, of Bancroft ; Ag-wah-setch, of Baptiste Lake ; W. Mitchener, of Humberstone ; C. Henderson, of Southwold ; —McCallum, of Dunnville ; P. E. Jones, of Hagarsville ; J. B. Freeman, M.P.P., of Simcoe ; — Henderson, of Toronto ; A. E. Otway Page, of Bertie ; W. A. Reaveley, of Simcoe ; Waters, Heath and Crouse, of Brantford ; W. Ireland and J. W. Fitzgerald of Parry Sound, and Rev. Mr. Gaviller, of Parry Sound.

The general work of the Institute has been well maintained. There were one special general meeting, twenty-four ordinary meetings, at which 33 papers were read, four meetings of the Geological section, at which four papers were read, fourteen meetings of the Biological section with fifteen papers read, independent of work done by sub-sections and "gossip" meetings, six meetings of the Historical Section with six papers read, making a total of 58 papers for the session.

The Librarian reports accessions to the library as under—

Donations	390
Exhanges (Vols.)	3,700

Of the above donations, 151 were presented by Mrs. Seidler, and 61 by the late Hugh Wilson, Esq. The list of exchanges embraces 516 societies ; among the exchanges are many of considerable value. Through this means the Institute is acquiring a library of reference in science in almost every branch, which will be greatly valued ere long. The importance of this part of our work was dwelt upon in the very able presidential address of Prof. Loudon in 1873, who at that early date recognized the great value of the interchange of publications between the scientific societies, as they tended to prevent individual workers from wasting time, money and strength in going over ground already

occupied, and brought workers in far distant and young countries into contact with the greatest minds of the older countries.

It is gratifying to notice the frequent reference to our transactions in our exchanges and to see papers written by our members translated into various foreign languages.

The much needed shelf space having been acquired, the books are now more readily accessible for reference. It is hoped that a catalogue will be prepared during the summer and be ready by the opening of next session.

The Council has special pleasure in acknowledging the services rendered by Mr. R. W. Young, M.A., the Assistant Secretary, in selecting and advising on the most advantageous exchanges, and his help in building up the Library. The commencement of the 4th series, under the name of the "Transactions of the Canadian Institute," has been very favorably noticed by many of our exchanges.

The Treasurer's accounts have been audited and found eorrect.

The membership has been increased by 37 elections. Eleven members have resigned, and 14 have been struck off the list for non-payment of annual subscriptions in arrears. There are 17 associates on the list.

An invitation from the Town of Penetanguishene asking the Institute to hold its next summer convention there has been accepted.

The thanks of the Institute are due and are tendered to the Press, especially the *Mail*, for its full reports of our meetings.

The Reports of the Sections are given as separate appendices.

The pressing needs at present are increased space for museum purposes and more funds.

The intellectual vigour of the Institute is being fully maintained. Tne practical part is suffering greatly from lack of funds to carry on the work.

A sketch plan has been prepared by one of our members, Mr. W. Knox, architect, outlining a scheme to utilize the vacant plot to the north, on Berti street, for museum purposes, at an estimated cost of about $5,000.

All of which is respectfully submitted.

CHARLES CARPMAEL,
President.

ALAN MACDOUGALL,
Secretary.

TORONTO, 1st May, 1891.

APPENDIX I.

LIST OF MEMBERS.

Honorary Members			7
Life Members			11
Ordinary Members, May 1, 1890		264	
Deaths	3		
Resignations	11		
Names erased	14	28	
		236	
Members elected in 1890-91		37	
			273
Total, May 1, 1891			291
Associates as at May 1, 1890		29	
Resignations	3		
Names erased	9		
		12	
Total, May 1, 1891		17	

APPENDIX II.

FINANCIAL STATEMENT.

James Bain, Treasurer, in account with the Canadian Institute, for the year ending March 31st, 1891.

To Summary.

To Balance in Imperial Bank	$ 270	45
" Cash in hand	5	22
" Annual Subscriptions	636	19
" Life Memberships	50	00
" Rent	12	00
" Government Grant	1,000	00
" Received from A.A.A.S.	510	79
" Periodicals sold	29	44
" Journals sold	17	61
" Interest on Deposits	18	10
" Sandford Fleming's Annual Donation	200	00
" Book sold	5	00
" Tickets to Niagara sold	16	65
	$2,771	45

By Summary.

By Salaries	$442 00
" Printing (Proceedings)	505 63
" " (Miscellaneous)	45 75
" Engraving	56 95
" Extra copies of Report	49 00
" Stationery	19 35
" Postage	109 21
" Freight and express charges	6 14
" Repairs	23 85
" Gas	31 29
" Periodicals	200 03
" Water	6 50
" Furniture	101 29
" House cleaning	58 75
" Fuel	80 30
" Taxes	10 28
" Advertising	3 00
" Museum expenses	25 25
" Insurance	59 50
" Interest	200 00
" Bust of Dr. Workman	10 00
" Niagara meeting	8 80
" City Directory	4 00
" Petty charges	3 85
" Balance in Imperial Bank	668 39
" Cash in hand	42 34
	$2,771 45

Examined and found correct.

(Signed) ARTHUR HARVEY, } *Auditing*
E. A. MEREDITH, } *Committee.*

April 17, 1891.

ASSETS AND LIABILITIES.

ASSETS.

Building and grounds	$18,000 00
Library	5,000 00

Specimens	5,000 00
Personal property	1,000 00
	$29,000 00

LIABILITIES.

Mortgage No. 1, due 1892	$3,000 00
Mortgage No. 2, "	1,000 00
Balance in favor of the Institute	25,000 00
	$29,000 00

Examined and certified. The "Specimens" are probably mostly not ours, only held in trust, so that this is only a memo., so far as that item is concerned.

(Signed) A. HARVEY, E. A. MEREDITH, } *Auditors.*

April 17th, 1891.

ARCHÆOLOGICAL FUND.

James Bain, jr., Treasurer, in account with the Archæological grant Canadian Institute, 1890-91.

To	Balance in hands of Curator	$ 15 20
"	" Treasurer	5 43
"	Government Grant	1,000 00
		$1,020 63

By	Purchase of Specimens, W. G. Long	$ 75 00
"	" " per D. Boyle	15 45
"	Cases	139 31
"	Lithographing, Rolph, Smith & Co.	40 00
"	Salary of Curator	400 00
"	Travelling and Miscellaneous Expenses, Curator	170 82
"	Balance in Bank	180 05
		$1,020 63

Examined and compared with vouchers which Mr. Bain pronounces correct. Charges and expenses reasonable.

April, 17th, 1891. (Signed) A. HARVEY, E. A. MEREDITH, } *Auditors.*

The undersigned auditors beg leave to report that the distribution of the various items of revenue and expenditure made by the Treasurer corresponds with the cash account kept by the Assistant Secretary, Mr. Young. They have checked this cash account with the vouchers and examined the bank book, finding the whole in order. The account of assets and liabilities includes as "specimens" property which the Institute is only holding in trust, and so far as this item is concerned, it is a mere memorandum. The auditors have also examined the accounts referring to the application of the special archæological grant, which are correct.

Respectfully submitted,

E. A. MEREDITH, } *Auditors.*
ARTHUR HARVEY. }

APPENDIX III.

PAPERS READ, SESSION 1890-91.

1890. Nov. 1. "The Canadian Institute of the Future,"—David Boyle, Ph. B.
" " 8. "The Two Values,"—W. A. Douglass, B.A.
" " 15. "Studies in Cell-Structure and Cell-Contents,"—A. B. Macallum, B.A., M.B., Ph. D.
" " 22. "The Typhoid Bacillus in relation to Drinking Waters,"—J. J. Mackenzie, B.A.
" " 29. "Occurrence of Gold and Silver in Galena and Iron Pyrites,"—R. Dewar.
" Dec. 6. "Reminiscences of Newfoundland."—Rev. Philip Tocque, A.M.
" " 13. "Report of the Delegate to the Montpelier Congress on the Romance Tongues, with remarks on some Ancient Races still existing in Southern Europe, their Languages and Customs,"—Arthur Harvey.
" " 20. "Sculpture,"—Fred. A. T. Dunbar.
1891. Jan. 10. "Colour in Nature (in relation to Drapery),"—W. A. Sherwood.
"Crystal Studies (No. 1),"—H. R. Wood, M.A.
" " 17. "Studies on the Origin of the Blood Pigment,"—Dr. Macallum.
" " 24. "African and American: the Contact of the Negro and the Indian,"—A. F. Chamberlain, M.A.
" " 31. "Canadian Art of To-day,"—J. W. L. Forster.

" Feb. 7. "Some Effects of Christianity on Legislation,"—Hon. William Proudfoot.
" " 14. "The Bœothick Indians,"—Alan Macdougall, C.E.
"Crystal Studies (Nos. 2 and 3),"—H. R. Wood, M.A.
" " 21. "Review of a Work by A. W. Moore, M.A., on Surnames and Place-names of the Isle of Man,"—Rev. Neil MacNish, LL.D.
" " 28. "Codification of the Law, 3rd Paper (Contracts),"—T. B. Browning, M.A.
" Mar. 7. "A Consideration of Sewage Schemes,"—Levi. J. Clark.
"A Few Words on Lake Currents,"—Levi J. Clark.
" " 14. "Indian Remains and Relics found in the neighborhood of Balsam Lake,"—G. E. Laidlaw.
" " 21. "Notes on French Canadian Folk-Lore,"—A. F. Chamberlain, M.A.
"Reforms in Time-Reckoning,"— Sandford Fleming C.M.G.
" " 28. "Some Points in Milk-Analysis,"—Prof. W. H. Ellis.
"The Administration of Governor Simcoe,"—Capt. Ernest A. Cruikshank.
" April. 4. "Miss Dix and her Life Work,"—E. A. Meredith, LL.D.
"Modern Ornithology,"—W. Brodie.
" " 11. "Japanese Literature,"—Tozo Ohno.
" " 18. "The Study of History,"—Rev. Prof. G. M. Wrong, M.A.
"The Genesis and Growth of Capital."—W. Houston, M.A.
" " 25. "A Gaelic Cuneiform Inscription,"—Rev. Neil MacNish, LL.D.
"British and Canadian Trade Relations,"—J. Castell Hopkins.
"Intelligence of Insects, as exemplified by *Pelopœus Cementarius*,"—W. Brodie.

Total, 33 papers, which may be classified as follows :—

Anthropology	3	Jurisprudence	1
Archæology	1	Literature	1
Astronomy	1	Metallurgy	1
Biography	1	Mineralogy	2
Biology	3	Miscellaneous	1
Chemistry	1	Philology	3
Economics	3	Sanitary Science	2
Fine Arts	3	Zoology	2
Geography	1		—
History	3	Total	33

READ AT MEETINGS OF SECTIONS.

Biological Section	15
Geological and Mining Section	4
Historical Section	6
Total	25

LIBRARIAN'S REPORT.

(Session 1890-91.)

To the President and Council of the Canadian Institute:—

GENTLEMEN,—Your Librarian begs leave to report as follows:—

The accessions to the library have been—

I. Donations	390
II. Exchanges	3,700

Of the above donations 151 were presented by Mrs. Seidler, and 61 by the late Hugh Wilson, Esq. The members are to be congratulated on this evidence of the interest taken in the Institute by the citizens of Toronto.

With reference to the exchanges, your Librarian would urge upon the Council the importance of this department of the Institute's work. In the very able address presented to the Institute by its then President, Prof. Loudon, in 1873, the great value of such scientific bodies was shown to be the conservation of energy that resulted from them, as they prevented individual workers from wasting time and strength in doing work that had already been done, besides affording our own workers access to the publications of similar bodies throughout the world. The praiseworthy efiorts and eager interest of our Assistant Librarian in its extension have brought our list of exchanges up to its present magnitude, and with the assistance of the Council there is no reason for us to stop here. If we look at the cost we shall find that this magnificent collection of scientific publications, already the finest with perhaps one exception in Canada, while one of our most valuable assets, has been purchased by the exchange of our own Transactions; in other words, by the increase of our reputation at home and abroad. Were the scientific spirit lacking, a sense of corporate, civic, and national pride should urge us to extend the knowledge of the important work being done by our members. Toronto is becoming one of the scientific centres of the New World, and with the

rapid growth of her colleges and technological schools the advantages of such a collection of exchanges will continually increase. It is the earnest hope of your Librarian that nothing will be done to decrease the progress of our exchange list, and thereby limit the usefulness of the Institute to all scientific workers.

With the object of increasing the interest of members in our exchanges, the Librarian has in contemplation a plan for abstracting the contents of the Transactions, etc., received, which he hopes to bring into effect during the next session.

A more pressing need, however, is that of a library catalogue. The exertions of the former librarian, Mr. Chamberlain, having introduced an orderly arrangement into the library, the important task remains of cataloguing the books. The majority of our members are probably ignorant of the varied collection of general literature which will be at their command when the catalogue is completed. This will probably be by the beginning of next winter's session.

DISTRIBUTION.

III. The number of societies, individuals and periodicals to which the publications of the Institute are sent	516
IV. Reading Room, Periodicals subscribed for	36
V. Total of separate numbers rec'd by purchase	834
VI. Number of books and periodicals taken out	1,551

Appended will be found a list of exchanges arranged according to countries, by the Assistant Librarian.

All of which is respectfully submitted.

DAVID R. KEYS, M.A.,
Librarian.

DONATIONS AND EXCHANGES.

(April 1, 1890, to April 1, 1891.)

I. Donations to library (of which 151 were presented by Mrs. Seidler, and 61 by the late Hugh Wilson)	390
II. Exchanges received from—	
Canada	200
United States	800
Mexico, West Indies and South America	73
Great Britain and Ireland	473

Austria-Hungary	145
Belgium	18
Denmark	5
France	572
Germany	901
Italy	177
Netherlands	36
Norway	16
Portugal	16
Russia	42
Spain	27
Sweden	24
Switzerland	24
British India	68
Java	28
China	4
Japan	24
Cochin China	2
Africa	5
Australasia	20
Total	3,700

REPORT OF THE BIOLOGICAL SECTION.

This Section has just closed another very successful session of fourteen meetings, at which fifteen papers have been read. One field-day excursion was taken to Howard Lake, at which there was a numerous attendance of members and friends. The Microscopical Sub-section, lately formed under the charge of Mr. G. G. Pursey, has held several meetings, and is now in good working condition.

The Ornithological Sub-section has done good work, judging from the report in the last issue of the Proceedings.

The Botanical Sub-section has done excellent work during the past session. Since it was formed about a year ago, 389 species of plants have been collected and identified, of which 325 species were found in the vicinity of Toronto, the balance (for most of which we are indebted to Miss Alice Hollingworth, of Beatrice, Muskoka), were collected in the northern parts of Ontario. This Sub-section having been considerably inconvenienced in its work by not having suitable accommodation for

the specimens collected, it was decided to file an application for a Botanical cabinet, which was granted by the Council of the Institute. The cabinet has been designed to hold pressed specimens, Coniferæ, and Cellular Acrogens, and to answer all the requirements of an Herbarium, besides being an ornament to the museum.

The Biological Section of the museum is now undergoing a thorough revision by Mr. James Noble, the present Curator. A schedule of papers is attached.

The officers for the ensuing year are,—James H. Pearce, *Chairman;* Chas. W. Armstrong, *Secretary.*

CHARLES. W. ARMSTRONG,

Secretary.

PAPERS READ.

1. James H. Pearce ..... *President's Address.*
2. An evening spent among the scientific books of the Public Library.
3. Wm. Brodie ..... *Accumulation of drift-wood by the River Don.*
4. G. Atkinson ..... *Notes on Ontario Birds (Continued).*
5. An evening spent in the museum by the members.
6. Chas. W. Armstrong..... *Review of the work done by the Botanical Sub-section.*
7. Chas. W. Armstrong..... *Ferns around Toronto.*
8. Wm. Cross ..... *Notes on Hybrids.*
9. Wm. Brodie ..... *Objects of the study of Ornithology.*
10. G. Atkinson ..... *Ornithological Report.*
11. G. Atkinson ..... *Habits of Native Birds in Captivity.*
12. Arthur Harvey ..... *Bone Caves of Europe in relation to pre-historic man.*
13. Wm. Cross ..... *Art of Taxidermy.*
14. James H. Pearce ..... *Ginseng, its medicinal properties and commercial value.*
15. Andrew Elvins ..... *Lower forms of Life.*
16. James H. Pearce ..... *Technical Etymology.*
17. Arthur Harvey ..... *Herpestes griseus in Jamaica.*

REPORT OF THE GEOLOGICAL AND MINING SECTION.

To the President and Council of the Canadian Institute :—

GENTLEMEN,—The Section can report on a very interesting session, which, although it started late in the season, aroused a great deal of interest, owing to the fact that the Ontario Mining Convention was held under its auspices.

At the meetings held during the year the attendance has been fairly good, and the members have evinced great interest in the proceedings, Mr. Mickle's series of papers on Nickel being followed with great attention and earnestness by many outside the scientific world, owing to the recent developments at Sudbury. These papers inaugurated an important new departure, in that they led from the scientific up to the practical working in connection with the subject. This treatment of mining and metallurgical matters is well worthy the attention of contributors of papers to the Section, even though it may necessitate more than one paper to carry it out.

The Section has continued its efforts to establish a provincial mineralogical museum, and a resolution calling the attention of the Government to the matter was passed by the Mining Convention. The establishment of a school properly fitted for education in mining was also pressed upon the Government.

The Section had moreover the gratification of seeing their action in moving for the appointment of a Department of Mines adopted by the Convention.

Officers have been elected as follows for the years 1891-92 :—Wm. Hamilton Merritt, F.G.S., *Chairman* ; Arthur Harvey, *Vice-Chairman* ; G. Mickle, B.A., *Secretary* ; D. Boyle, A. Elvins, T. R. Clougher, R. Dewar, P. H. Bryce, M.D., *Committee* ; James Noble, *Curator.*

The following papers were read before the Section :—

Jany. 29th. "Notes on the Production of Iron and Steel in Ontario,"—Mr. Hamilton Merritt.

Feby. 26th. "Progress of Mining Legislation in Ontario,"—Mr. Hamilton Merritt.

March 26th. "History and Occurrence of Nickel,"—Mr. Geo. Mickle.
April 16th. "Nickel Assaying,"—Mr. Geo. Mickle.

(Signed) WM. HAMILTON MERRITT, *Chairman.*
GEORGE MICKLE. *Acting-Secretary.*

REPORT OF THE HISTORICAL SECTION.

The Historical Section, organized on the 15th July, 1890, for "the study and investigation of the history of Canada and cognate subjects, such as Archæology, Genealogy and Ethnography," reports with pleasure that 27 members of the Institute have signed the roll.

1. The officers for the past year have been:—Mr. J. C. Hamilton, M.A., LL.B., *Chairman;* Mr. Arthur Harvey, *Secretary;* Messrs. Wm. Houston, M.A., D. A. O'Sullivan, LL.D., G. M. Rae, *Committee.*

2. The following papers have been read at meetings of the Section:—

Wm. Houston, M.A., on "The Genesis and Development of Legislative Functions in the Northern Parts of America."

J. G. Ridout—"An account, written by the late Hon. Thos. Ridout, Surveyor-General of Canada, of his captivity among the Shawnees in 1788."

Wm. Houston, M.A., on "The Development of Legislative Autonomy in Canada."

J. C. Hamilton, M.A., LL.B., on "Afro-Canadian Incidents, and the Career of John Brown in Canada."

D. B. Read, Q.C., on "Incidents in the Life of Gen. Brock."

J. G. Ridout, on "The Campaign of 1815 (Waterloo)."

Wm. Houston, M.A.,—A Transcript (with illustrative maps and comments) from the diary of Mr. Alex. Macdonell, who had accompanied Gov. Simcoe on an expedition from the Humber Bay to the Georgian Bay, by way of Lake Simcoe, in 1793.

3. The subject of publication by the Provincial Government of manuscripts of importance to the history of Ontario was brought before the Institute by this Section, and a deputation appointed to wait upon the Administration in reference thereto. At the interview which shortly followed, the Hon. Atty.-General Mowat requested that deputation to forward a memorandum in writing of such documents as they thought should in this connection receive consideration. The preparation of this

memo. having been by the Institute referred to this Section, that duty was carefully performed, and a report duly sent to the Hon. the Atty.-General, after its adoption by the Institute. The last clause of that report is repeated here, viz., "The committee think that some person should be employed to make special enquiry about the valuable historical documents in the possession of private families, and to procure the originals or copies thereof. The same person could be instructed to procure the interesting relics of pioneer life for a provincial museum."

4. The section has supported a proposal to join with others in celebrating the centenary of this Province in the present year.

5. The officers for next year are:—Mr. J. C. Hamilton, M.A. LL.B., *Chairman*; Mr. Arthur Harvey, *Secretary*; Messrs. Wm. Houston, M.A., John G. Ridout, W. Canniff, M.D., M.R.C.S.; *Committee.*

Respectfully submitted, as adopted by the Historical Section on the 23rd April, 1891.

ARTHUR HARVEY,

Secretary.

NOTES ON NICKEL.

By George Mickle, B.A.

(*Read 26th March, 1891.*)

The purpose of this paper is to describe briefly the history of Nickel and the Nickel production down to the discovery of the Canadian deposits. What the history of Nickel in the future will be is impossible to foresee and depends on many uncertain factors. Nickel occurs in nature :—

(1) As native Nickel in meteorites, and one occurrence is reported in Greenland in basalt.

(2) In combination with Oxygen—Ni O as Bunsenite, but only as a mineral curiosity—occurs in small green octahedrons of glassy lustre.

(3) With Carbon dioxide—as Texasite ; occurs as a fine coating over Chromeiron ore in Texas, Spain.

(4) With Silica. There are a number of compounds of Nickel and Silica, and they play an important part. The few specimens here will serve as types of the rest. First we have Chrysopras and Chrysopal, which are simply Quartz and opal respectively, containing a small amount of Nickel Oxide.

Then there are a number of Silicates with slightly varying amounts of water and having all a greenish appearance. One will serve as a type of the rest.

The most important, however, of the silicates is the Garnierite (of New Caledonia). It is a Magnesia Silicate containing varying amounts of Nickel. I have here also another Magnesia Silicate containing Nickel. The Silicates deserve attention, not only because a large part of the supply of Nickel is derived from Silicates, but also because important finds of Silicates are reported in various parts of the world.

In combination with Sulphuric Acid it occurs in nature only as a curiosity (Lake Huron, Spain).

The arsenic compounds of Nickel are—

Nickeline Ni As light copper red in color, high specific gravity; frequently has a green coating; an important mineral.

Chloanthite Ni As_2 tin white in color, crystalized in cubes ; also important.

Rammelsbergite Ni As_2, belongs to the rhombic system.

In combination with Sulphur, as Millerite Ni S, brass yellow color,

crystals grouped together like a sheaf or in fine, hair-like crystals. There are also two other compounds of Nickel with Sulphur Saynite Ni_3, S_4, and Beyrichite Ni_5, S_7, which are very rare, and Lillihammerite, found in Norway, 2 Fe_2, S + Ni S, not magnetic.

In combination with Antimony, as Breithauptite Ni Sb, isomorphous with Nickeline, light copper red color.

As a Sulpho-Arsenide, Gersdorfite, Ni As S, greyish tin white in color, occurs in octahedrons.

As a Sulpho-Antimonide. As Ullmannite, rare.

As an Arsenate, as Nickel Bloom, an Arsenate containing water, and is a product of decomposition of the arsenides.

Besides these Nickel minerals we have the Pyrrhotite, containing Nickel, and some Lead, Copper and Silver ores give considerable amounts of Nickel during the process of smelting.

The composition of the Meteorites is especially interesting, and I will not pass them over with a mere mention.

Meteorite, composed of non-metallic and metallic components.

Non-metallic	48.94%
Metallic	61.06%
	100.00

The metallic part was made up of

Nickel-Iron (Fe_9 Ni)	98.995
Phosphor Iron, Fe_2 P	0.539
Phosphor Nickel Iron (Fe Ni)$_4$ P	0.293
Silicium Iron (Fe_2 Si)	0.330
Mono-Sulphide of Iron (Fe S)	0.030
Carbide of Iron	Trace
Copper	0.035
Asmanite	0.056
	100.278

Analysis of whole metallic part :

Iron	89.99
Nickel	9.74
Cobalt	0.23
Copper	Tr.
Phosphorus	0.15

Silica	0.04
Carbon	Tr.
	100.15

Analysis of Phosphor Nickel Iron :

Iron	40.68
Nickel	48.16
Phosphor	11.16
	100.00

This analysis is only for one particular Meteorite, the composition varies somewhat in all. One case is known where Nickel predominates, namely, Meteorite from Oktebbeha, Ni 60% Fe 30%. Each meteor iron has a continuous structure and is a single individual, and is found to consist of a kernel of iron poor in Nickel, (Kamacite) ; imbedded in a thin leaf of Iron, richer in Nickel, (Taenite). These lamellae are arranged according to the surfaces of an octahedron; and filling up the cavity of the octahedron is a third Iron, poor in Nickel. Imbedded promiscuously in the mass are a Mono-Sulphide of Iron and a Phosphor Nickel Iron.

The chief difference between meteor Iron and artificial Iron is the lack of the continuous structure in the latter, and in fact this is carefully avoided, because artificial Iron as a rule contains no Nickel, but a not inconsiderable amount of Carbon, which in the case of a continuous structure produces a high degree of brittleness, as the Carbon in the form of Graphite collects together in leaves along which the Iron is easily cleavable. In the case of meteor Iron the continuous structure is due to the scaly structure of layers of Iron containing greater or less amounts of Nickel, whereby the Iron gains an enormous amount of toughness. If it were possible to imitate this structure and produce a Nickel Iron of this scaly form, it would be a great stride in the manufacture of Iron.

Schreibersite or Phosphor Nickel Iron has also been found imbedded in the basalt of Greenland.

Of the other Nickel Minerals, Nickeline, Chloanthite, Smaltine containing Nickel, and Millerite are of importance. It is remarkable that the two ores from which by far the greater part of the Nickel supply of the world is obtained are not Nickel Minerals at all, the Nickel is only present as an accident. Thus Garnierite is a Magnesia Silicate containing water and impregnated with varying amounts of Nickel Oxide, sometimes to 45%, and forms a vein in olivine bearing basalt. And the Pyrrhotite, which we are so familiar with and which is a Sulphide of Iron, in which

some of the Iron is sometimes, not always or even generally, replaced by Nickel.

With regard to the mode of the occurrence of Nickel, there are several types. Nickel minerals, as most others, shew a preference for certain associations. One such is the occurrence of Nickel, Cobalt and Bismuth in veins. Especially in this connection do we find Smaltine ($Co\ As_2$), Linneite ($Co_3\ S_4$), Nickeline, Chloathite, Gersdorfite, Millerite. The gangue matter is brownspar and ironspar, and this occurrence is found in granitic schists, porphyry and gneiss (Northern Italy, Saxony).

Another association is Nickel and Cobalt with Quartz. In the Ural there is a vein over six feet wide in chlorite shales and serpentine, the rock matter is quartz and chrysopras. In the cavities of the quartz is a clay which contains lumps of Nickel Arsenate as large as apples.

A third is Nickel, Cobalt and Silver with Carbonates (Dopschau Hungary). One such occurrence is found in gabbro surrounded by clay-slates, at the boundary of the gabbro and clayslates the veins are found. The veins are compound and consist of rock with fine veins of ore yielding about 20% Nickel. The carbonates with which it occurs are ironspar, calcspar, brownspar (also Saxony and California).

A fourth association is Cobalt, Nickel and Silver with Baryta, also Bismuth and Uranium. The Nickel occurs as Speiss Cobalt and Nickeline chiefly and forms veins in cyrystalline slates. (Saxony, Bohemia.)

The next association is that of the Silicates. Of the Silicates the New Caledonia deposit is by far the most important, and is especially interesting because there is strong reason to believe that we have here a genuine case of lateral secretion; that is, the Nickel was contained in the neighboring rock; in this case, in the olivine probably as a Silicate. Now the Silicate of Nickel is soluble in water, and still more soluble in water containing Carbon dioxide. The rock matter on either side of the vein is decomposed for a considerable distance, and it is believed that the Nickel has been dissolved, carried by water through minute crevices to the vein and there deposited. Other occurrences of Nickel as Silicate bear a marked resemblance to this. I may mention in this connection an important find of Nickel lately made in Germany, also a Silicate. The rock matter in this case is a clay colored reddish by Iron Oxide and occurring in a zone of decomposition of serpentine. The ore is formed exclusively of Silicates. Schuchardite, a soft green Silicate, predominates.

The last occurrence I shall mention is Nickel in Magnetic Pyrites. This occurrence is the most interesting to us, but has also been found in many other places. In Norway the most important occurrence of Nickel

is near the town of Lillehammer. The region consists of gabbro and Amphibolite, and the ores are Magnetic Pyrites with 2 to 3% Ni and Lillehammerite with 22% Ni.

Also in Black Forest, Germany, occurring in gneiss rock, and Rooras in Norway. Here the ore only contains 0·25% Nickel. Also at Tunaberg, in Sweden, where a limestone containing Magnetic Pyrites and Copper Ore occurs in gneiss. These are all in crystalline slates.

In the massive rocks we have another occurrence at St. Anthony's Nose, in New York, in syenite. One such deposit is 45 feet in width; the Magnetic Pyrites contains 3% Nickel. One occurrence in Diorite is at Val Sezia, in Italy. It has been observed that hornblende bronzite and olivin seem to be favorable to the occurrence of Nickel.

METALLURGY.

The metallurgy of Nickel is comparatively young, so far as the European nations are concerned; but Nickel was known to the Chinese, and had been employed by them from remote times. In 1776 Engestrom drew attention to Nickel. He found on analysing the alloy called Packfong, of which various implements brought from China were made, that it contained Nickel as an essential component, and Nickel had probably been employed in China for hundreds, perhaps thousands of years, for Baktrian coins, bearing the inscription of King Euthodymus, who lived about 200 B.C., are found to have almost the identical composition of the nickel coins of the present day.

The history of nickel in Europe begins with the fruitless efforts of German miners to produce Copper out of a Nickel mineral, which from its appearance they thought must contain Copper. As their efforts were unsuccessful, true to nature, they abused the mineral and called it Kupfernickel or Copper-devil, a name which it retains to the present day. This mineral was, up to the middle of the 18th century, considered as partly a Copper compound, from the green color of its solution, and partly as a Cobalt ore from the blue color which it imparts to glass fluxes, due to Cobalt contained in the ore. It was not till 1751 that Cronstedt shewed that there was no Copper in this mineral, and explained the true nature of Nickel. He also shewed that the Speiss, which remained in the manufacture of Cobalt blue, was essentially Nickel and not, according to the belief of that time, a burnt Cobalt that had lost his soul.

Cronstedt's view met with much opposition. Bergmann in 1775, misled by the magnetic property of Nickel, said that Cronstedt had the

metal in an impure state and that it still contained iron. At about this time the fall of meteorites, containing considerable quantities of Nickel, was announced from different parts of the world, so that towards the end of the 18th century the existence of Nickel was admitted and its properties understood.

The first Nickel works in Europe were built in 1824, in lower Austria, by Gersdorf, whose name we have preserved in the mineral Gersdorfite. The operations were at first confined to the arsenides, and it was not till 1838, when Berzelius, the celebrated Swedish chemist, discovered Nickel in the Pyrrhotite of Klefva in Sweden, that Metallurgists began to pay attention to the Sulphides. The first experiments were not very successful; the Iron was not separated till all the Sulphur had been removed; the ore was roasted as strongly as possible and an iron alloy with about 60 per cent Ni produced. This was smelted down several times with Quartz, and finally a product was obtained which contained 70 to 80 per cent Ni, 18.22 Cu, 1.52 Fe, and was called crystallized Nickel. This process required a great outlay in fuel and labor, and more Nickel was lost in the slag than was won.

Later, about 1850, other experiments were made, leaving the Sulphur in the ore, till all the Iron had been removed.

In 1856, the discovery of an extensive deposit of Nickel ore in Pennsylvania increased the use of the metal still more, and again in 1874, through the discovery of Nickel in New Caledonia, the price of Nickel was still further lowered and many of the works in Norway compelled to stop work. Finally, the discovery of extensive Nickel-bearing deposits in Algoma district (Canada) must exercise a great influence on the use of Nickel.

Physical Properties.—Nickel has specific gravity, 8.9. Point of fusion 1392°-1420° C. Nickel has the property of absorbing gases in the molten state and giving them out again on cooling, thus forming blisters and making castings very difficult. Through the improvements of Wharton in Philadelphia, and Fleitmann in Iserlohn, who employed various methods to purify the metal, castings of 100 lbs. or more can be made. It possesses great malleability; sheet Nickel of .015″ thickness can be produced without difficulty.

One gram can be drawn out into wire 600 feet long Nickel can be welded on Steel or Iron, the covering can be made so thin as .00039 in. The strength of Nickel is greater than that of Iron and about equal to Bessemer Steel.

Chemical Properties.—Nickel does not oxidize at ordinary tempera-

tures, even in moist air; in the presence of acids it rusts, although not so much as iron. It is only slightly attacked by cold acids, except dilute nitric. The molten alkalies also do not attack it. Here are analyses of some of the alloys of Nickel, also of the Nickel coins. Experiments made to protect Iron from rust by alloying it with Nickel have shewn that the alloy rusts as easily as Iron, and it is not till the alloy contains .37 per cent Ni. that the Nickel makes its influence felt.

Various impurities exercise a great influence on the physical properties of Nickel. Of these, Iron, Arsenic, Sulphur, Silicum and the oxides have the greatest influence on the brittleness of Nickel. Arsenic and Sulphur when .1 per cent is present make Nickel cold short.

Oxygen present as Nickel Oxide to the amount of 0.304 per cent. makes castings brittle. Malleable castings are found to contain not more than 0.084.

Silicum, which is taken up when Oxide of Nickel is smelted in presence of Quartz and Charcoal, shews its influence when present in very small quantities.

Phosphorus, up to 0.30 per cent., increases the hardness at the expense of the malleability.

Chlorine is always found in Nickel prepared in the wet way when chlorides are present. Such Nickel cannot be rolled.

ALLOYS.

	Copper.	Zinc.	Nickel.	Iron.	Silver.
Packfong (China)	40·4	25·4	31·6	2·6	—
German Silver (Sheffield)	63·4	17·01	19·13	—	—
German Silver (Germany)	54·0	28·0	18·0	—	—
Silverine	71-79	1-7·5	16-16·5	1-1·5	—
Argent de Mousset (Paris)	59·06	9·57	3·42	—	27·56

COINS.

	Copper.	Nickel.	Zinc.
Switzerland	—	100	—
United States	75	25	—
Brazil	75	25	—
Venezuela	75	25	—
Germany	75	25	—
Belgium	75	25	—
Chili	70	20	10

PRODUCTION OF NICKEL *(According to Kerl).*

(China not included.)

In 1880. Price of Nickel $1.10 per lb.

Germany	480	Tons.	
United States	150	"	(130-190).
Austria	110	"	
Brazil	110	"	(In 1875 price $2.60 per lb.)
Sweden and Norway	75	"	Norway 310 Tons.
Belgium	20	"	Sweden 50 "
France	20	"	
	965		

In 1888. Price of Nickel 60 cts. per lb.

New Caledonia	450	Tons.	(8240 tons of ore at $25 per ton.)
Germany	400	"	
United States	95	"	
Austria	75?	"	(No further statistics to hand since
Brazil	75?	"	1881.)
Norway and Sweden	50	"	
France	30	"	
Belgium	20	"	
	1195		
Canada	?		

N.B.—These statistics are given in meter tons (=2214 lbs ; to reduce to tons of 2000 lbs. add one-tenth), and the amounts are credited to countries which produce the ore ; England accordingly, as she manufactures her Nickel from imported ore and matte, does not appear on this list.

It will be seen from the above statistics that the fall in price of Nickel has not materially increased its use, and also that the amount produced in the various countries has undergone a considerable change. The reason for this will be apparent when we have gone into the methods of smelting the various ores. I shall therefore come back to this point again.

The method of the production of Nickel can be divided into two groups, namely : the production from Arsenides and Sulphides, and the production from Silicates. I shall first briefly describe the treatment of Arsenides and Sulphides ; and, as the treatment varies slightly, I shall take the Arsenides first.

We have here to deal with the Nickel Arsenides already mentioned, and the different products from the smelting of Lead, Silver and Copper ores, which contain Arsenic, and in which Nickel can only be detected in traces or not at all in the charge; but through repeated smelting the Nickel becomes concentrated in the Speiss in such quantities that it is worth working. Thus in smelting Silver ores from Mexico, in which no Nickel can be detected, a small amount of Speiss is found, which is concentrated and sold. This amounted, in 1889, to 61 tons, and was sold for $7,700.—(Freiberg.)

This is interesting not only as shewing how minute quantities in the charge through concentration attain important proportions, but also shews the great affinity of Nickel and Cobalt for Arsenic, and of Copper for Sulphur, all the Copper almost combining with Sulphur and forming a Matte, and the Nickel and Cobalt forming a Speiss. Furnace bears also contain Nickel.

In order to collect all the Nickel in the Speiss, the ores are generally first roasted and then smelted. Roasting is necessary when Sulphur or an excess of Arsenic is present; that is, more Arsenic than is necessary to form the compounds—$Ni._2$ As. $Co._2$ As.; because, during the subsequent smelting, Nickel and Cobalt are protected from slagging so long as the above compounds can be formed. When this roasted product is subjected to a reducing smelting in a blast furnace, the Arsenates are reduced in the upper part of the furnace, and the reduced mass on coming in contact with the blast is oxidized again, and generates arsenious acid; the Nickel and Cobalt Oxides in contact with Iron Arsenide form Nickel, and Cobalt Arsenide and Ferrous Oxide is set free, which is immediately taken up by the slag. It is therefore necessary that Arsenic is only so far removed by the roasting that only the Iron is oxidized.

The Speiss contains, however, still considerable amount of Iron, and in order to remove this it must be subjected to the same process repeatedly.

The following furnace has been employed with good success:—(Flechner's furnace).

Or instead of this repeated roasting and smelting the Speiss is sometimes subjected to a blast in a reverberating furnace, sand or quartz is strewn on the molten surface, and the slag is repeatedly drawn off till all the Iron is gone and the slag begins to be colored blue by the Cobalt.

The metals are slagged in the following order, according to their respective affinities to oxygen—Iron, Cobalt, Nickel. Iron, while slagging, shews a film or scales on the surface. Cobalt is clear, and Nickel

shews the scales again. This process is, in fact, Plattner's assay for Cobalt and Nickel carried out on a large scale.

I now come to the treatment of the Sulphides. This is a more tedious operation, as the ores are generally not so rich as the Arsenides. The same principle is pursued, namely, to collect all the Nickel in a matte and then treat the matte further. The ore is first roasted to remove part of the Sulphur, and is converted partially into oxides. This product is then smelted, and the Nickel combines with the remainder of the Sulphur, while the Iron in conjunction with the Silicates which are already present in the ore, or are added purposely, forms a slag. It is impossible to effect this separation of Iron and Nickel in one operation, because it would produce such an enormous amount of slag at once; the operation must therefore be repeated several times. The resulting matte is then smelted under a blast in a reverberatory furnace or in a Bessemer converter, and then further refined with Baryta and Quartz or with Saltpetre and Soda in order to be finally treated in the wet or dry way.

The reaction of the Baryta and Quartz on Iron Sulphide is interesting.

$3\ Ba\ SO_4 + 4\ Si\ O_2 + Fe\ S + Ni\ S.$
$= 3\ Ba\ Si\ O_3 + 3\ S\ O_3 + Si\ O_2 + Fe\ S + Ni\ S.$
$3\ S\ O_3$ in the high temperature breaks up into $4\ S\ O_2 + O.$
$= Ba\ S\ 1\ O_3 + 4\ S\ O_2 + O + Si\ O_2 + Fe\ S + Ni\ S.$
$= 3\ Ba\ S\ 1\ O_3 + 4\ S\ O_2 + Fe\ Si\ O_3 + Ni\ S.$

The method of treating the Sulphides can be divided into the following parts:—

1. Roasting the ores.
2. Smelting the roasted ore to matte.
3. Roasting the matte.
4. Smelting the roasted matte.
5. Blowing the concentrated matte.
6. Refining, smelting of matte.

The ore is generally roasted in heaps, with wood as fuel. Analyses of different parts of the roast heaps shew that a concentration towards the middle and bottom of the heap takes place, which can probably be explained by assuming that the easily fusible Sulphides of Copper and Nickel sicker out through the mass, grown porous by the roasting.

We have perhaps here an explanation of the fact frequently observed in the deposits of Nickel-bearing pyrites, namely, that the deposit becomes richer in Nickel as one goes down. Assuming that the molten mass of Iron and Nickel Sulphide was originally homogeneous, as it

gradually cooled off the more difficultly fusible Iron Sulphide would harden first, leaving a spongy mass, while the Nickel Sulphide, still remaining liquid, would seek the lower levels. The next operation, smelting the roasted ore, generally takes place in a shaft furnace, not high, on account of the formation of Iron bears, which takes place when the ore is exposed long to a reducing action. The great difficulty of this smelting is the formation of bears in the furnace, so that the furnace can not run more than about three weeks. These bears are extremely tough and must be sometimes broken by dynamite. Recent improvements have, however, greatly reduced this difficulty. (Sudbury).

The next operation, the roasting of the matte, can be done in heaps or a reverberatory furnace. The smelting of the roasted matte can be performed either in shaft or reverberatory furnaces. Quartz and limestone must be added here in order to slag the Ferrous Oxide in an easily fusible, double Silicate. We have now to do with a mixture of Fe S, Ni S, Cu_2 S, with metals dissolved in them, which is proved by the fact that on cooling, crystals of a metallic appearance separate out, which, on being analysed, shew their metallic nature.

The next operation, blowing the concentrated matte, can be performed on a small refining hearth, like a Copper hearth. The hearth is first warmed with charcoal, then filled with coke, and when the coke is burning well, it is charged with the concentrated matte in large pieces. This soon melts and collects under the coke. The blast is now let play on the surface of the molten metal, the Iron thereby oxydized, and forms in connection with the material forming the hearth and coke, a slag which flows off regularly. The smelter can tell the end of the process by observing whether the fresh fracture of a test piece possesses a light gray colour. The coke is then taken off and the blast continued till the mass has hardened.

The composition of this product had in one works (Ringer)—

29.79 Copper,
40.45 Nickel,
6.1 Iron,
22.27 Sulphur.

In Lyons, the raw matte is treated in a Bessemer converter till the Iron is nearly all gone. Thus out of a raw matte containing—

6.0 Nickel,
2.0 Cobalt,
0.75 Copper,
38.25 Iron,

53.00 Sulphur,

a product was obtained which held—

55 per cent. Nickel,
15 per cent. Cobalt,
6 per cent. Copper,
2 per cent. Iron,
20 per cent. Sulphur,

which is given over to the electrolytical process.

We now come to the conversion of Speisses and mattes into crude Nickel. This can be done indirectly in two ways, a dry and a wet. Let us first take the dry way. The Speisses and mattes are roasted strongly with constant stirring in the furnace described before, till a test piece, taken from the mass, does not smell any more of Arsenious or Sulphurous Acid; the last traces of Arsenic and Sulphur are removed by a fusion with Saltpetre and Soda. The fusion can take place in any furnace which is built in such a way as to exclude the formation of reducing gases; the following reaction takes place: The Sulphur combines with Sodium to form Sodium Sulphate, and sets free Carbon Dioxide. As the heat increases the Sodium Sulphate fuses, the whole mass swells up and Carbon Dioxide escapes, and the remaining traces of Sulphides and Arsenides are laid bare and oxidized by the Saltpetre. When the process is finished no smell of Sulphur Dioxide or Arsenious Acid can be detected.

We now come to the conversion of Speisses and mattes to Nickel Oxide in the wet way. This is simply a laboratory process on a large scale, and is not often employed. Briefly, it consists in dissolving in Sulphuric or Hydrochloric Acid, precipitation of Copper, Lead, Arsenic, &c., with Hydrogen Sulphide; oxidation of Iron by Chlorine or Chloride of Calcium and precipitation of Iron with Carbonate of Calcium; separation of Cobalt by Chloride of Calcium (in warm and neutral solution) (or Ammonium Sulphate separates Nickel); precipitation of Nickel with Chalk or Soda.

Then the Nickel-hydrate precipitate is ignited in order to convert it into a difficultly soluble condition. The Gypsum which is formed during the process must be removed. This can be done by fusing with Carbonate of Soda, thereby forming a Sulphate of Sodium and Carbonate of Calcium, both of which can easily be extracted by water containing Hydrochloric Acid.

The next step is the reduction of oxide to metal. Either Nickel powder is made or small cubes. To make the powder the oxide is stamped together with charcoal and fused in a crucible. To make the

cubes the Nickel Oxide is formed into cakes, then ignited with coal dust. The ignition takes place also in crucibles.

Care must be taken not to let the Nickel, after the reduction, remain long in contact with coal, otherwise Carbon will be taken up and the physical properties of the Nickel thereby deteriorate.

As Nickel is almost always alloyed with Copper, an alloy can be made direct from the concentrated Matte, by treating it in a Bessemer Converter till only traces of Iron and Sulphur remain.

Thus, here is a Matte and the resulting alloy—

Nickel,	32·59	39·90
Copper,	52·00	59·50
Iron,	0·42	0·64
Sulphur,	17·11	——
Arsenic, Antimony	0·11	——

The direct process by electrolysis was at first not successful. The Speisses and mattes containing Copper were hung as electrodes in a bath of dilute Sulphuric Acid, and the Copper deposited on the negative electrodes. The Nickel and Iron were allowed to collect in the bath till the acid is nearly neutralized. A great part of the electrical is thereby wasted on the generation of hydrogen, and the Copper is deposited impure. An amount of Sulphuric Acid equivalent to the Nickel contained in the positive electrode is used, which is lost in Nickel vitriol. The iron is then precipitated by Ammonia, and the liquid is evaporated down to produce pure Nickel Sulphate, or is electrolyzed to produce Metallic Nickel. This process proved to be not economical.

This process must be carried out analogous to the Copper deposition; that is, the Nickel and Iron must be dissolved out of the anode or positive electrode with the proper strength of current. The precipitation of Iron on the negative electrode can be avoided by the alkaline nature of the bath. Copper and Sulphur must remain in the anode and be treated separately afterwards.

The processes we have hitherto considered closely resemble the Copper smelting processes; but, when we come to the treatment of the Silicates, a different picture is presented to us. Here we have to do more with an Iron process.

The New Caledonia ores, for instance, are smelted with coke in a furnace about 25 feet high, under 12cm. mercury pressure of hot blast The temperature of the blast is 400° C. Fluorspar, soda, manganese ores, Iron ores, are added to the charge. Out of one ton of ore

about 230 lbs. of crude Ferro Nickel is produced, of the following composition :—

Carbon,	1·70	per cent. to	3·40	per cent.
Silicum,	2·40	"	0·85	"
Sulphur,	0·55	"	1·50	"
Iron,	23·30	"	32·35	"
Nickel,	75·50	"	60·90	"
Cobalt, Copper, Manganese,	Traces.			

This crude Ferro Nickel is taken to France and treated in a Siemens-Martin furnace on a hearth of Nickel Oxide, where it is decarbonized, while Iron, Silicum and Manganese are slagged. During the process Nickel Oxide is added to remove the Carbon. Towards the close of the operation, a crude Nickel containing oxygen is added in order to remove the excesses of oxygen. Ferro-Nickel is used in the manufacture of Nickel Bronze, along with Tin, Zinc, Copper.

The ore is sometimes mixed with an equal weight of Sulphuric Acid, then boiled with water and Ammonium Sulphate added. This precipitates Nickel as Nickel Ammonium Sulphate, which is the form it is required in for plating. The poorer ores, that is ores with less than 7 per cent. Nickel, are melted with Pyrites, Gypsum and Iron ore. The resulting product contains about 50 per cent. to 60 per cent. Ni., 15 per cent. to 25 per cent. Iron, 25 per cent. Sulphur; or instead of adding Iron ores, Copper ores can be used, and the result is a crude Copper Nickel.

The New Caledonian ores and the Silicates generally can be treated by a wet process, resembling the treatment of Speisses and mattes.

I now come to the refining of crude Nickel. During the process of producing crude Nickel, new impurities are taken up and the amount is sometimes increased. This is especially the case of Silicum Oxygen and Carbon. It is impossible, for instance, to decarbonize Nickel by a puddle process without the metal absorbing oxygen ; besides, the molten Nickel absorbs Carbon Monoxide, which is formed in the process of decarbonization and makes it impossible to make solid castings. The method of refining it is first of all to remove Silicum and Oxygen, and then reduce the newly-formed Nickel Oxide.

The Carbon can be best removed by a puddle process or by the addition of Nickel Oxide. Garnier, of New Caledonia, decarbonizes his Nickel in a Bessemer converter, and lets the blast play on it till all the Iron is oxidized and goes off in the slag. This method is open to the objec-

tion that the point to stop the blast is difficult to determine, and either a good deal of Iron is left behind or some Nickel is lost in the slag. The removal of oxygen without generation of Carbon Dioxide, which would of course blister the metal, is effected by the addition of various substances, such as Phosphorus, Manganese, Potassium Ferrocyanide, Magnesium. The addition of 1.20 of a per cent. Magnesium has been found to be sufficient to remove all the oxygen (Fleitmann, Iserlohn). About 2 per cent. Manganese ore is used by some metallurgists.

Phosphorus is largely used in France. Garnier employs an equal amount of a Phosphorus Nickel alloy, containing 6 per cent. Phosphorus.

A patented process employed in Paris produces wrought Ferro-Nickel direct from Nickel Matte, by smelting the Matte with Potassium Ferrocyanide and Manganese Super-Oxide, and then adding a small amount of Aluminum at the moment of tapping. The product of 70 per cent. N., 30 Fe., was produced from 71.9 Ni. Matte, 12 per cent. of 63 per cent. Manganese Oxide, 16 per cent. Ferrocyankalium, 0.1 per cent. Aluminum.

I wish now to say a few words in explanation of the statistics given and to explain the effect the fall in price has had on the industry in the various countries.

The collapse of the Nickel industry in Norway and Sweden is due not to any deterioration in the ores or to their exhaustion. The ore was there a magnetic pyrites, containing in the best mines 2.3 per cent. Nickel, but no other metals of value.

In Germany, the mode of occurrence is altogether different. There are small quantities of the rich Cobalt and Nickel Arsenides associated in the one case with Bismuth, and in the other with Silver, and small deposits of Silicates. The mines are worked more for the sake of the other metals associated with the Nickel, and the Nickel must be separated in the course of smelting, and is, as it were, a bye-product, and the amount produced is not generally affected by the price.

Thus one works (Schneeberg) smelted in one year :—

700	tons	Cobalt, in value,	$299,000.	
119	"	Nickel, "	131,000.	
55	"	Bismuth, "	88,000.	$518,000.

The Nickel industry in the United States has met with the same fate as the Norwegian, although to a somewhat less degree, the chief ore being there also a magnetic pyrites bearing Nickel. The occurrence in Austria is similar to that in Germany.

When we consider the methods of production of Nickel from the various Sulphides or Arsenides, and then see the simplicity of the Silicate smelting, how by one operation a rich alloy of Nickel with very few impurities is obtained from the raw ore, it is not to be wondered at that the New Caledonian mines control the price of Nickel for the whole world, and will continue to do so till the deposits are exhausted. This time is by all indications not far distant, for formerly the medium quality of the ore contained 7 to 15 per cent. Nickel, and the rich ore over 15 per cent. Nickel, but at present 5 or 6 per cent. is ranked as the best quality. And when this deposit is exhausted the price of Nickel must go up again, totally irrespective of any new use to which it may be put in forming alloys. The Canadian mines should then occupy the position that the New Caledonian ones have in the past.

THE LUMINIFEROUS ETHER.

By J. M. Clark, M.A., LL.B.

(*Read 19th January, 1889.*)

Before proceeding to point out some of the properties of the luminiferous ether, I may be asked, How do we know that such a substance exists? Is not the very existence of the ether a mere theory, and as such a part of one of those systems of which Tennyson says, "They have their day and cease to be?" Eye hath not seen it, ear hath not heard it, the hands of man have not handled it. The balances of the most skilful physicist have not weighed it, nor has the most powerful reaction of the chemist detected it.

Yet not only are physicists certain of its existence, but Tyndall has justly remarked (in his work on Molecular Physics) that its relations to the matter of the universe must mainly occupy the investigations of future scientists; and in his recent lectures on Molecular Dynamics, Sir Wm. Thomson said that we know the luminiferous ether better than we know any other kind of matter in some particulars; that we know more about it than we do about air, water, glass or iron.

In the first place we all know that the heat and light of the sun, which are now conclusively established to be *forms of energy*, are transferred to the earth, and from the sun our main supplies of energy undoubtedly come.

Some recent writers seem to think that the demonstration of the impossibility of what is called "action at a distance" has been the work of recent years. But long ago Newton said (in one of his famous letters to Bentley), "That one body may act upon another at a distance through a vacuum without the mediation of anything else by and through which their action may be conveyed from one to another is so great an absurdity that no man who has in philosophical matters a competent faculty of thinking can fall into it."

We have seen that the sun acts on the earth through the transmission of heat and light from the sun to the earth.

From this one of two things follows, either (1) heat and light are substances, forms of matter, which has been conclusively established to be impossible, or (2) the heat and light being, as they indisputably are *forms of energy*, must be transformed by the mediation of *something*.

That something, whose existence is thus proved, we call ether, and since its function was at first supposed to be the transmission of light it was called the luminiferous ether.

Now, however, it is supposed and indeed may be considered as proved that this wonderful ether (whose name is derived from its connection with the now generally accepted undulatory theory of light) performs functions of a much more varied and important nature. The recent investigations of natural philosophers show that it also acts as a medium for conveying not only light but also radiant heat, magnetic disturbances and other forms of energy. Indeed the term luminiferous is so misleading and inadequate that in a paper read before this Institute seven years ago I rather presumptuously ventured to suggest that the term 'energipherous' would be more appropriate. Not only does the ether act as a medium for the conveyance of heat, light, &c., but it also plays a very important part in transforming one kind or rather form of energy into various other forms. The well established fact that light is capable of producing various chemical changes shows that the vibrations of the ether particles in which consists light may be transformed into the motions of the atoms of bodies, since all chemical changes result from accelerations of these motions.

The fact that heat is developed in certain chemical transformations indicates the relation of the forces of chemical affinity to heat. The relation of heat to light may be seen by considering the nature of radiant heat but is best shown by considering certain experiments of Leslie, which prove that bodies are heated by absorbing light. In performing one of the experiments devised by him for the purpose of ascertaining the mechanical equivalent of heat, Joule discovered that current electricity was a form of energy and subject to the law of conservation. His results were extended by Helmholtz, Meyer, Clausius and Thomson, till the law of conservation has been shown to govern all natural forces. Thomson demonstrated that Faraday's discovery of the rotation of the plane of polarization of a polarized ray of light produced by media under the influence of a powerful magnet, involved the dependence of magnetism on motion in the case of both magnetic and diamagnetic bodies.

To Helmholtz and Carpenter is principally due the credit of having extended the principles of the conservation and transformation of energy to physiological phenomena.

From data supplied by Weber, Maxwell found that electro magnetic disturbances were propagated with the same velocity as light. The

explanation of this he held to be that electricity, like light, was due to the undulatory vibrations of the medium which is beyond question necessary for the propagation of light. This fact is at the foundation of Maxwell's electro-magnetic theory of light which is no doubt destined to play no unimportant part in the development of the true Theory of Energy. Thus by considering in succession all the so-called natural forces it will be seen that they are all simply manifestations of an unchangeable amount of indestructible energy. Every form of energy is capable of being transformed by suitable manipulations into all its other forms without in any case involving any increase or decrease in the total quantity of energy. But, while the quantity of energy in the universe is invariable, yet by virtue of laws of which we have a particular instance in Clausius' Second Main Principle of the Mechanical Theory of Heat, the amount of available energy is being constantly exhausted. This is simply another method of saying that no known natural processes are perfectly reversible. In the transformation of these various forms of energy into one another the ether plays, as at once follows from what has been said above, an important part.

Then not only does the ether convey light from the sun to the earth but also from the remotest visible star. Indeed the functions performed by it are so varied and of such a nature that this mysterious ether must pervade not only all interstellar but also into intermolecular and interatomic space

Not only does the existence of the ether explain the fact of the propagation of light from the sun and stars to the earth, but it also very clearly explains all the other known phenomena of light. As pointed out by Sir Wm. Thomson, all these properties come out as a matter of course from the dynamical consideration of the subject. So much so that any one not knowing these phenomena would have discovered them in working out the matter dynamically. He would have discovered anomalous dispersion, fluorescence, phosphorescence, etc. Indeed, Sir Wm. Thomson says that he never heard of anomalous dispersion till "he found it lurking in the formulas," and as a consequence he very pertinently remarks that the dynamical treatment which discovers what is afterwards verified by experiment, is a very important piece of dynamics. We have then the observed and ascertained facts which are explained by the existence of the ether, and there being no other known method of accounting for the facts, we conclude that the ether is a reality and not the creation of scientific imagination.

Having thus proved the existence of the ether, and having pointed out a few of the functions fulfilled by it, let us briefly consider some of its more

important properties. In the first place then ether is matter, since in order to the performance of the functions which we have above described, it is absolutely essential that it should possess inertia, and inertia is the distinguishing test of matter. That matter is inert, and that inertia is the distinguishing test of matter, are propositions, the truth of which lie at the foundation of modern physics.

Before leaving this subject we may refer, by the way, to the bearing of this on the important question, Are there two essentially different kinds of energy, *kinetic* and *potential*? If potential energy be defined as the *energy of position*, its existence is utterly inconsistent with the above propositions. In this sense potential energy involves a contradiction in terms. But though there is and can be no fundamental difference as the basis of the distinction between potential energy and kinetic energy, all energy being in its nature kinetic, yet if we regard potential energy as a convenient name for those kinds of energies whose nature is not yet understood, the term is convenient and admissible, though liable to create considerable confusion.

From a moment's consideration of the constitution of matter it follows that the ether must of necessity be a highly attenuated substance.

Yet, in order to convey heat and light with the enormous velocity with which they travel, and to account for the almost instantaneous transformations of energy observed in explosions, etc., the ether must be so elastic and incompressible that Stallo in his "Concepts of Modern Physics" has justly characterized it as an adamantine solid.

In order that we may have a more definite idea of the properties of this marvellous substance, I may mention that in a paper read before this Institute some years ago I attempted a calculation of its probable density.

The calculations showed that the mass of a cubic mile of ether is not less than $\frac{1}{4}\left(\frac{1}{10}\right)^{13}$ of a pound and not more than $\frac{1}{4}\left(\frac{1}{10}\right)^{7}$ of a pound. That is, a sphere whose radius is 95,000,000 miles from the sun (the distance of the earth from the sun) would contain at least 4,400,000 tons of ether. By a somewhat different method, Sir W. Thomson has shown that a cubic mile of ether in the space traversed by the earth contains not less than $\frac{1}{1000 \times \left(\frac{1}{10}\right)^{5}}$ of a pound. As pointed out by Prof. Tait the method of Sir W. Thomson gives only the minimum density. It may also be pointed out that the density of the ether is approximately uniform throughout the solar system. As has been remarked by S. Talan Preston in his interesting Essay on the Physics of the Ether, the law established by Clausius as the result of his investigations of the constitution of gases, viz., that "the mean length of path of a particle is in

the same proportion to the radius of the particle (supposing it to be spherical) as the unit volume of space is to the total volume of particles contained in such unit volume" applies to the ether. From this beautiful law many important and exceedingly interesting consequences follow, but I shall not detain you by pointing them out. From the low density of the ether taken in connection with the functions it has to perform, and especially the necessity of the ether particles being able to penetrate with freedom the intermolecular and interatomic spaces it follows that the component particles of the ether must be extremely minute.

The density of the ether being small, and its particles being minute, it follows that in order to produce pressure necessary to effect the rapid and stupendous changes observed in nature, the velocity of the component particles of the ether must be correspondingly great. Green, in his masterly treatment of the subject, has exhaustively worked out the wave theory of light on the hypothesis that the medium is continuous and homogeneous and nothing of moment has been added to what he has done. But, as is well known, his results do not correspond with observed facts, so that his explanations are unsatisfactory and incomplete. The Undulatory Theory of Light as developed by him thoroughly explained dispersion and absorption, but did not explain reflection and refraction at plane surfaces, and what has aptly been called the hopeless difficulty of double refraction in crystals, stands in the way of the final acceptance of the theory as at present developed.

No explanation of these difficulties has yet been given which can be regarded as complete or satisfactory, and their solution is the work of the future.

It is quite obvious that their successful solution will throw a flood of light on the whole question of the real nature of matter.

THE BŒOTHICK INDIANS.

By Alan Macdougall, M. Can. Soc. C. E.

(Read 14th February, 1891.)

This powerful but peaceful nation has been completely destroyed by the white man. The earliest notice of them is in Hackluyt's account of the discovery of Newfoundland by Cabot in 1497, who says of them: "The inhabitants of this island use the skins and furs of wild beasts for garments which they hold in as high estimation as we do our finest garments. In war they use bows and arrows, spears, darts, clubs and slings."

Hayes, who was second in command to Sir Humphrey Gilbert, about 1583, says, "the savages are altogether harmless." Capt. Richard Whitbourne, writing in 1622, describes them as "ingenious and tractable, full of quick and lively apprehension, willing to assist the fishermen in curing fish for a small hire."

This race was cruelly exterminated by the French, who imported the Mic-Macs from Nova Scotia to make war upon them.

In 1769, the British government took an interest in the nation and issued a proclamation prohibiting their being molested and killed. Rewards were offered for the capture of an Indian; in 1804, a woman was captured, treated kindly, loaded with presents and sent back to her tribe, which she never reached; a strong suspicion is entertained that she was murdered by the man to whose care she was entrusted.

In 1810, Lieut. Buchan, R.N., was commissioned by the Governor, Sir Thomas Duckworth, to discover and bring about friendly relations with the Indians. He cruised up the bay of Exploits and at length came on an encampment. He prevailed on two Indians to come on board his vessel; but to effect this, he had to leave two of his marines with the Indians as hostages. His object in taking them on board was to send back by them presents for the Indians. On his return to their encampment he was horrified at finding the headless bodies of his men. It is supposed the Indians got alarmed at the delay and feared he was returning with reinforcements to capture them. The Indians had fled from their camp after the murder; the hostages escaped from Buchan and were never again seen.

In 1819, a party of furriers captured an Indian woman at Red Indian

Lake, after shooting her husband and another Indian. She was brought to St. John's and called Mary March, after the month in which she was taken, treated with great kindness, and in the hope of conciliating her tribe and opening communication with them, she was loaded with presents and sent back to her people. She died on the voyage, having been a sufferer from consumption; the party in charge of her placed her body in a coffin, wrapping muslin around it and left it on the margin of a lake so as to be found by her people, who conveyed it to Red Indian Lake, where it was found by Cormack. The manners of Mary March when in St. John's were very pleasing. There was a quiet dignity about her which induced the belief that she was a chief's wife. She had been dead for several years when found by Cormack.

Four years after the capture of Mary March, three other red Indian women were captured near Twillingate and brought to St. John's. These were the last of the tribe seen alive. They were a mother and two daughters. The mother and one daughter died in a short time, the other lived for six years, learned English and became a useful servant, but died of consumption, a disease, as she said, fatal to many of her tribe. Her name was Shanandithet. She had a wonderful talent for drawing. Soon after her arrival in St. John's a piece of paper and a lead pencil were given to her, and in a few strokes she drew a deer perfectly, and what was more remarkable began at the tip of the tail.

In the museum are several hand sketches, showing the route of Buchan's expedition in 1810, the massacre of the marines, and the flight of the Indians, which were drawn by Shanandithet who was with the tribe at the time. The sketches are remarkable for their accuracy in giving the numbers of Indians and whites. They show where the marines were killed and the route of the fugitive Indians. The papers are very interesting. It is the earnest hope of the writer that Mr. Howley may soon be able to give a detailed history of these expeditions as gathered from the various monographs under his charge.

Cormack, the traveller who crossed the island in 1822, made a final effort in 1828 to discover the remnant of the red Indians, which were supposed to be in existence, in order to open up friendly communications with them. He and his party penetrated to Red Indian Lake, the headquarters of the Bœothicks, but could not find a single person. They found numerous relics of the race, such as clusters of wigwams, storehouses for venison, canoes, etc. In one of the burial huts they found two bodies wrapped in deer skins on the floor, one was the body of Mary March, which was in a white deal coffin, neatly shrouded in white muslin. Beside the bodies were two small wooden images, representing husband

and wife, and a doll, representing a child ; also arrows, a quiver, fire stones (iron pyrites), and other things.

Of their customs and habits a few words must suffice in this place. Their winter mamateeks, or wigwams were conical. Their frames were of poles covered with skins or birch bark, stoutly constructed, though they looked very light. Several had withstood the storms of over thirty winters. They were made to accommodate from six to eighteen persons. The fire was in the centre ; round it were a number of holes, one for each person, in which the occupant sat, and it is supposed slept. For increased comfort the holes were lined with moss.

The remains of a vapour bath were also found, the construction was ingenious ; large stones were heated in the open air by burning stones round them, the ashes were then removed, a hemispherical frame work, closely covered with skins to exclude the external air was fixed over the stones. The patient crept in under the skins, taking with him a birch rind bucket of water and a small dish to dip it out ; on pouring water on the hot stones he could raise the steam at pleasure.

They produced fire by striking together two pieces of iron pyrites, a custom peculiarly their own, and not known to exist among other tribes.

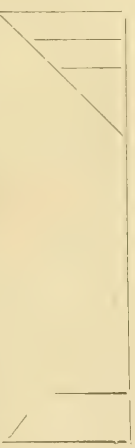
They had four modes of sepulture which varied according to the rank of the deceased. One of the repositories resembled a hut 10 feet by 8 or 9 and 4 or 5 feet high in the centre, floored with square poles, the roof covered with rinds of trees and in every way well secured inside against the weather and the intrusions of wild beasts. Another resembled that of our own Indians, the body was wrapped in birch bark and with the property of the deceased placed on a sort of scaffold about 4½ feet from the ground. The scaffold was formed of four poles about 7 feet high, fixed perpendicularly in the ground, to sustain a floor 5 feet 6 inches long by 4 feet broad, the floor was made of small square beams laid close together horizontally on which the body and property lay. A third method was when the body was bent together and wrapped in birch rind and enclosed in a sort of box placed on the ground ; the box was made of small square posts laid on each other horizontally and notched at the corners to make them fit closely ; it was 4 feet long, 3 feet wide, 2½ feet deep, well lined with birch rind to exclude the weather ; the body lay on its right side. The last and most common way was to wrap the body in birch rind and cover it over with heaps of stones on the surface of the ground in some retired spot. Sometimes the body thus wrapped was put under the surface a foot or two and the spot covered with stones. In some places where the ground was soft and sandy the graves were deeper and no stones were placed over them.

They were great hunters and fishermen, and had an ingenious method of trapping deer. They constructed a long fence of timber by chopping down trees, leaving openings at certain spots for the deer to enter. The fences opened out into large "corrals" or enclosures, or led to the lakes, in both of which the deer were slaughtered. Some of these drives are forty miles in length, and can easily be traced at the present day.

The most interesting remains in the museum are two skulls and several of the parts of two bodies, a mummified body of a boy, and an almost complete skeleton of a man, along with a fine collection of bone ornaments.

These Indians do not appear to have been great stone workers. A few examples of cults, hoes, scraping tools for hide dressing have been found. They did not use pottery. Their culinary utensils were of birch rind, from the size of a teacup up to a two-gallon pail. This practice is still in use among the Mic-Macs. For light they appear to have used soap-stone lamps of rhomboidal shape 5 inches long on major axis, at one end of which is a small notch in which the wick lay, the oil being obtained from the seal and fat of the deer. It is surmised they used these lamps in a similar manner to the Esquimaux of the present day Of arrow heads there is evidence of the same shapes and materials as those used by the western Indians. Some patterns, apparently of later. date, are of slate, with very keen, sharp edges, and one of iron with a razor edge on it. These are made at the angle of 45°, a marked difference to the usual equilateral triangle.

The bone ornaments are very interesting being the first which the writer has met with. There are two styles, one used for ornamenting the hair, the other the dress; they are all well shapen, elaborately figured, and on none are the figures or patterns duplicated. The form of pattern is a right angled triangle, in which there is either one or two divisions. Each style of ornamentation is separate, the double division does not appear on the single division specimens. The hair combs are chiefly two-pronged, although there are a good many three-pronged specimens; they range from 2 to 3 inches in length, are not rudely or coarsely carved, and present a variety of patterns. The small tooth comb, of which there are several examples, are like those of the Esquimaux, the teeth are from ½ to ¾, of an inch long. On some large pieces of ivory evidently intended for dominoes, the carving takes the shape of the letter H. This ornament runs through many of the specimens. All these ornaments have been cut



out of the bones and tusks of walrus, deer and the seal, and are dyed a dark sienna color. They were worn as a fringe to the upper garment, and sometimes as a deep necklace.

The body of the boy is an interesting relic. It was found in 1886, and exhibited at St. John's in October of that year. The body was wrapped in deer skin, which fitted it closely. Attached to the skin were an ornamental fringe of the skin, thirty-two ornamental bone objects similar to those described, and some bird claws. This was enclosed in birch rind, closely and beautifully sewn. In the grave were found a small wooden image, a doll dressed or covered with birch rind, a bow, some arrows, beautifully polished arrow-heads, two pairs of moccasins, a rind basket containing some smoked salmon, and several dried trout wrapped in separate parcels. The preservation of the skin is the most interesting question. It covers the whole body except the skull, is of dark color, and appears like soft, tanned leather. The body is bent up, and was on its left side when found.

In September, 1888, the skeleton of an Indian was found by Mr. Jas. Templeton, near Comfort Head. When found it was in a bent-up position, the chin resting on the knees, and was held in that position by a rope. The arms were at the side, bent at the elbows, so that the arms crossed the legs. The head had been covered with deer skin. The body lay on its right side, the head to the north. Broken arrows were placed across the body, the ornaments put between the doubled up legs and the body. It is supposed to be the body of a medicine man, from the narrow chest and contents of a medicine bag, which were a number of carved bone charms, strings of wampum, a brilliant piece of iron pyrites, and several bird skulls. The coffin had not been sewn. The birch rind had been put on the bottom and turned up over the body, with a few stones placed on it to keep it in place.

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SURNAMES AND PLACE-NAMES OF THE ISLE OF MAN.

By Rev. Neil MacNish. B.D., LL.D.

(Read 21st February, 1891.)

Such is the name of a book which has recently been published, and which contains very useful information, not for Manxmen merely, but also for Celtic scholars everywhere. "My aim in the following pages," the author writes, "is to give a complete account of the Personal names and Place-names of the Isle of Man." The author of the book in question, is Mr. A. W. Moore, M.A., a gentleman of scholarly attainments, who has devoted much attention to the literature and topography of Man, and who has earned for himself an honorable reputation owing to his patriotic efforts to revive and perpetuate whatever is of value in the history and traditions of his native Island. Mr. Moore is a member of the House of Keys, and resides at Cronkbourne, a name which reveals its Gaelic lineage at a glance. In January, 1885, he started a quarterly journal of matters past and present connected with the Isle of Man, to which he gave the modest name of "The Manx Note Book." Mr. Spencer Walpole, the present Lieutenant-Governor of Man, wrote an introductory notice, wherein, among other things, he remarked :—"Let it not be said that Man is too little, and that Manxmen are too few for such a publication. The Isle of Man can at least boast that it has preserved its independence unimpaired, and that it still possesses the old legislature which had its origin before the Battle of Hastings. Fifty thousand people still retaining their old laws and their old customs in the centre of the United Kingdom is a spectacle as unique as it is notable. Their annals necessarily possess a peculiar interest to the antiquarian and the historian." So far as the articles of the Note Book and the printing of this book are concerned, the expectations of its readers were more than adequately satisfied. Mr. Moore, however, unhappily found that he was incurring a heavy pecuniary loss in publishing the Note Book; and hence, much to his own regret and to the regret of his numerous friends, he was reluctantly led to discontinue the publication of it with the twelfth number, which appeared in October, 1887. The Lieutenant-Governor was asked to write what he termed the Epilogue of the Note Book. He thus concludes his Epilogue :—"And so far as artistic merit cannot compensate for a defective balance sheet, the time has come for closing this

experiment and for saying farewell. Yet, in thus bringing his labors to a premature conclusion, the editor of this Manx Note Book may have the satisfaction of reflecting that no good sound piece of work ever perished altogether. The Manx Note Book disappears, but its old numbers will be treasured by their possessors, and perhaps some people, when they are trying to complete their sets, will regret that their active admiration was too late, and that they did not bestow on the Note Book while it was still alive the support which might have averted its doom."

Though all lovers of Celtic literature have cause to regret that Mr. Moore, whose knowledge and enthusiasm and resources are abundant, did not receive generous assistance in connection with the Note Book; Manxmen can compare very favorably with their Irish and Scottish cousins in their desire to rescue from oblivion and to perpetuate whatever is of greatest value in the prose and poetry and folk-lore of their Island. There was formed in 1858 a society bearing the designation, "The Manx Society for Publication of National Documents of the Isle of Man." Up to 1886 twenty-nine volumes were published by that Society. In the October number of the Manx Note Book for 1886, an account is given of the foundation of the Manx Society, of the work which it undertook to accomplish, as well as of the work that still remained to be performed. An account is also given of the financial position of the Society and of the appointment of four new members of the Council. As Mr. Moore is one of the four, it may be fairly hoped that he will exert himself in the endeavor to carry on to a larger extent the laudable work for which the Society was organized.

There is unfortunately too much reason to justify the accusation, that Celts are fond of contenting themselves with sentimental affection for their language and literature; and that they are somewhat tardy in befriending those scholars who are anxious to perpetuate the language, and to keep the flame of love for the language of their fathers alive and burning in the hearts of the children of every generation that appears on the scene. The Irish Gaels, who have a magnificent heirloom in the form of a very ancient and copious literature, have in recent years been exerting themselves, with a large amount of warmth and energy, in the interests of all that is distinctive in the government and institutions of their country.

It cannot fail to occasion surprise that, while so deep and widespread a feeling exists among Irish Celts for the independence of Ireland, there are few among their leaders who can speak the language of their forefathers. Though they cannot be accused of having an undue affection for the Sassenach, they have chosen to abandon their native language,

which is Gaelic, and to adopt the language of those whom they are taught rightly or wrongly to regard as otherwise than friendly to themselves and their country. There was started some years ago in Dublin, in the best interests of Irish, a journal bearing the designation, "Iris Labhar na Gaedhlige, The Gaelic Journal, exclusively devoted to the preservation and cultivation of the Irish language, founded, conducted and published by the Gaelic Union." The Gaelic Union had in contemplation the very excellent object of encouraging the study of Irish in the schools of the country, and altogether of infusing fresh vitality into the attention which the language and literature of Ireland ought to receive from Irish Celts. Though the aims of the Gaelic Union and of the Journal were patriotic in an eminent degree, it must be confessed that the support which in all fairness might be expected, has not been extended either to the Gaelic Union or to the Gaelic Journal. In an article which appeared in one of the numbers of the Journal for 1889, the editor adverts in doleful terms to the prospects of that periodical. "The Gael, a Monthly Journal Devoted to the Cultivation and Preservation of the Irish Language and the Autonomy of the Irish Nation:" Such is the designation of a journal which has been published in Brooklyn, N.Y., for the last ten years. It has to be said in favor of that journal, that it is ably conducted, and that it is rendering even on a foreign soil excellent service to the language and literature of Ireland. The Welsh easily claim the palm among the Celts for intrepid devotion to the language and traditions of their forefathers. So deeply seated is the affection of the Welsh for their native language, and so beneficial is the influence of the Eisteddfods which are now held annually, that the prediction may be hazarded that the future has nothing which is not hopeful and assuring regarding the perpetuation of Welsh in all its rugged grandeur in the Principality of Wales. Through the heroic efforts of Prof. Blackie, in whose veins, as he is fond of asserting, there is not a drop of Celtic blood, a Celtic chair was established in the University of Edinburgh a few years ago. To him largely pertains the praise which results from knowing, that throughout the Highlands of Scotland, and in those cities where Gaels reside in large numbers, Societies exist for the avowed object of honoring and continuing the study and knowledge of Gaelic, and of the traditions of the Highlands. A movement which promises fairly to lead to important results, is now on foot for instituting in the Highlands of Scotland annual Eisteddfods after the example and in the spirit of the Eisteddfods which are annually held in connection with Wales, and which have already done incalculable service in the way of continuing and developing all that is best in the poetry and prose, in the music and traditions, of the Welsh.

Prof. Rhys, of Oxford, contends that the Isle of Man has proved the meeting-place for Ivernians, Goidels, Scandinavians, and Englishmen. Mr. Moore divides the history of Man into three parts :—

1. When it was inhabited by a Celtic people exclusively.
2. The period of the Viking invasions and the establishment of Scandinavian rule.
3. The period during which Man came under English dominion.

It is to be regretted that he employs the term Celtic to designate the Goidelic branch merely, and not the Cymric as well. The term Celtic is usually and wisely made to perform the comprehensive duty of embracing all the branches of the Cymric and Gaelic families of the Celtic language. Mr. Moore has been at great pains to study the meaning and origin of the Scandinavian names of places that occur in Man. He has had the valuable assistance of the late Dr. Gudbrand Vigfusson, of Oxford, who was a Norse and Runic scholar of great ability. It is found that in nearly every case Scandinavian names are Celticized, *i.e.*, they have received the prefix Mac—a prefix which was almost universal in the sixteenth century. There is an old distich wherein the quantity of *o* in duobus is changed :—

Per Mac atque O, Tu veros cognoscis Hibernos ;
His duobus demptis, nullus Hibernus adest.

i.e.

" By Mac and O, you always know
True Irishmen, they say,
But if they lack both O and Mac
No Irishmen are they."

It does not appear that *O* ever took root in the Isle of Man—though *Mac* was widely prevalent. As any Scottish Gael can determine for himself, *Mac* indicates *son*, while *O ogha* indicates grandson or descendant. MacNeill and MacDonell are forms which pertain to Scottish Gaelic, while O'Neill and O'Donell are characteristic of Irish. *Mac* is made to do duty in presenting in an English dress the names of both sexes in Gaelic, *e.g.*, John MacNeill, Mary MacNeill. *Nic*, which is a contraction for *nighean*, daughter, is used in Gaelic to designate females, *e.g.*, Mairi Nic Eallair.

It is somewhat anomalous that Mac should be made to represent both sexes in English. Those Gaels who aim at transforming their names entirely into English, convert *Mac* into *son*, and append son to their names, *e.g.*, Anderson, Johnson, Stevenson. Little do those who are in the habit of eliminating *a* from *Mac*, and of writing *Mc*, reflect that

they are leaving out the essential letter in *Mac*, and that *M* or *c* could with far greater impunity be omitted. Indeed, in certain parts of Scotland *M* or *Mh* in *Mac* or *Mhac* is silent in colloquial conversation, and *ac* alone is audible, *e.g.*, Iain *ac* a' Phearsuinn.

Mr. Moore avers that surnames in Europe may generally be divided into four classes :

1. Those taken from the personal names of an ancestor.
2. Those taken from trades and occupations.
3. Those which originally indicated place of birth or residence.
4. Those which were originally descriptive of a person's appearance or character or residence.

It has been ascertained that of the surnames which are now in use in Man, 68 per cent. are purely Celtic. Any man of intelligence can understand, that in the early days of human civilization when books were largely, if not entirely, unknown, the power of observation of the people of those days was very acute and accurate ; insomuch that the names which they gave to rivers and mountains, &c., had as their basis an unmistakable similarity or foundation in nature itself. Mr. Moore has, therefore, abundant reason on his side when he asserts, that those who gave the names, so far as places are concerned, considered such names to be accurate descriptions of the localities to which they are applied, and that they are never mere arbitrary sounds, but have a rational significance. In acknowledging the authorities that aided him in the preparation of his book, Mr. Moore, among other books, mentions Cleasby & Vigfusson's Icelandic Dictionary, and the Annals of the Four Masters. The latter book bears the designation of the *Annals* of the Four Masters, because four men were prominent in the preparation of it. The chief of those men was Michael O'Clery, than whom no lover of his country has any where to present a finer exhibition of cheerful devotion to duty, of large contentment with poverty, and of patriotic affection for all that was great and good in the annals of his people. The work in question was begun in Dun-na-ngall, or Donegal, on the 22nd January, 1632, A.D., and was finished on the 10th August, 1636. It has been truly said, that no other nation has such a monument of historical learning as the Annals of the Four Masters contain in connection with the history of Ireland. It is stated in the book in question "that *Giolla*, especially among the ancients, signified a youth, but was generally a servant ; and hence it happened that families that were devoted to certain saints, took care to call their sons after them, prefixing the work *Giolla*, intimating that they were to be servants or devotees of those saints, and it will be found that there are few saints of celebrity from whose names those

of men were not formed by the prefixing of *Giolla*." Among English writers in our own day, the word Gillie passes as current coin.

There are many Gaelic and Manx surnames which are formed from Giolla, *a servant*, and the name of a saint, *e.g.*:—

Gaelic Names.

MacLean, Mac Ille Eoin, or Iain, the son of the servant of John, or Saint John.

MacLennan, Mac Ille Fhinnein, the son of the servant of Finnan, or St. Finnan.

MacLellan, Mac Ille Fhaolain, the son of the servant of Faolan, or St. Faolan.

MacCallum, Mac Ille Chaluim, the son of the servant of Columba, or St. Columba.

Gilchrist or Mac Gilchrist, Mac Ille Chriosda, the son of the servant of Christ.

Kilpatrick, Mac Ille Phadruic, the son of the servant of St. Patrick.

Gillespie, Mac Ille Easpuig, the son of the bishop's servant.

MacAndrew, Mac Ille Aindreis, the son of the servant of St. Andrew.

Jamieson, Mac Ille Sheumais the son of the servant of James.

Manx Surnames.

Kissack, Mac Guilley Isaac, the son of the servant of Isaac.

Quane, Mac Guilley Shane, Johnson, or the son of the servant of John.

Mac Vorrey, Mac Guilley Vorrey, the son of the servant of Mary-Morrison, Murray, Currie.

Mac Mychel, Mac Guilley Michil, the son of the servant of Michael, Carmichael.

Fayle, Mac Fayle, Mac Guilley Phoil, the son of Paul's servant, Mac Phail.

Mac Faden, Mac Ille Phaidin, Little Patrick's son.

Bridson, MacGuilley Brighde.

Mr. Moore gives a list of surnames that are derived from personal names of purely native origin, *e.g.*:—

Quarry, MacGuaire, Guaire's son.

Quine, MacCuinn, Conn Counsel.

Connelly, MacConghalaich (congal conflict).

Cannell, MacConail, Conal's son.

Mr. Moore is incorrect in his contention, that Domhnall is the diminutive of the root *Dom* in *Dominus*, master. The common derivation of Domhnall or Donull, *donn*, brown, and *suil*, eye, is far preferable. It is also incorrect to derive Dughall from *dubh*, black, and *Gall*, a Lowlander, inasmuch as stress is laid on the first syllable *Dubh*. In the second syllable *suil* is clearly present.

Kelly, MacCallaigh, Callach, war strife.

Moore, O'Mordha, mor great.

Curphey, Murchie or MacMurchy, MacMurchada, Muir, sea, Cathaide, warrior.

Kneal, Niall, champion.

Colvin, Calvin, Calbhin, call, bald.

Coole, Cooil, MacCumhail, Comhal, Courageous.

MacNameer, MacNamara, MacConmara, cu dog and mara, sea.

MacRory, Ruaidhri, ruadh righ, red king.

"MacDecan, MacPherson, and MacOspagie, Dean's or Deacon's son, Parson's son, and Bishop's son, are the strongest theeves that be." Such is a citation that Mr. Moore makes in connection with Celtic surnames from trades or occupations. Of such surnames these are examples :—

MacTaggart, the son of the Priest.

Ward, Mac a' Bhaird, the son of the Bard.

Tear, MacIntyre, Mac an-t Saoir, the son of the Carpenter.
Gown, Smith or Smithson, Mac a' Ghobhain, the son of the Blacksmith.

Kerd, Caird, Ceard, an artificer.

Gill, Giolla, a young man. Gill in Scottish Gaelic is to be derived from *Gall*, the full name being Mac a' Ghoill, the son of the Lowlander or Stranger.

MacPhearsan, MacPherson, the son of the Parson.

Mac y Chlery, Mac a' Chleirich, the Clerk's son.

When Great Britain and Ireland were subjected to the rude invasions of the Northmen, the Danes made inroads on the eastern coast, and the

Scandinavians, properly so-called, made their incursions into the western parts, and therefore, into the Isle of Man and the Hebrides. So strong and stable and resolute was the Celtic population of the Isle of Man, that the Scandinavians who settled there, adopted the prefix *Mac*, and thus became in name part of the Celts among whom they lived. Of such names these are examples :—

Castell, a contraction of Mac as Ketill, the son of the Kettle. Mac Askel, Makaskil, Caskill are other forms of the same name.

Corkill, a contraction of Mac-por-ketill, the son of Thor of the kettle. Thorr, the God of Thunder, the Keeper of the Hammer, the destroyer of evil spirits, the son of Mother Earth, was the favorite deity of the North. MacTorquil, Mac Corquodale, MacCorkyll, are other forms of the same name.

The name MacLeod, which is so common in Scotland, is of Scandinavian origin. Corlett is the Manx form of the same name. Ljot, which corresponds to Leod, means *people*, and therefore MacLeod signifies the son of the people. It appears that the MacLeods of Scotland have always claimed a Scandinavian origin. The MacLeods of Lewis not only quarter the Manx trie cassyn (three feet) but also use the same motto, "Quocumque jeceris stabo." In the names of some of the Western Isles of Scotland, there are indelible evidences of the presence and power of the Scandinavians. Lewis, Barra, Scarba, Jura are not Gaelic but Scandinavian terms. Such personal names as Norman or Tormoid, Lewis, Godfrey, Farquhar, Ranald, are Scandinavian and not Gaelic at all. When MacAulay incurred the odium of the Scottish Gaels for his severe and unnecessary strictures on the method of life which their ancestors pursued, it was not commonly known that the name MacAulay is a shortened form of MacAmhlaith, Anlaf's or Olaf's son. Olaf was a royal name in the Isle of Man. Though MacAulay's great-grandfather was minister of the small Isles, as they are termed among the Hebrides, it is possible to find an explanation of the historian's antipathy to the Gaels of Scotland, in the re-appearance in his person of the hostility which his forefathers bore, or had cause to bear, towards the rightful owners of the soil. The Gaels of Eastern Ontario are unconsciously doing homage to the Scandinavian origin of the term Ranald ; forasmuch as in Gaelic, as well as in English, they gave prominence to the vowel *a* and not to *o* in the first syllable. Clan Ranald, Clann Raonuill, Raonuill, Raonull: in such terms, deference is properly paid to the etymological meaning of the Scandinavian appellation. Raghnall, the Celtic form of Ragnvaldr, is compounded of ragn the God and valdr, ruler. MacRannall, &c., MacRaghnaill, Reginald's son, are other forms of Raghnall.

It appears that after the year 1333, many of the distinguished Anglo-Norman families that settled in Connaught and Munster became Hibernicized, Hibernis ipsis Hiberniores, spoke the Irish language, and assumed surnames like those of the Irish by prefixing Mac to the Christian names of their ancestors, *e.g.*:—

Gale, Mac an Ghaill.

Quillam, MacWilliam.

Kinry, MacHenry.

Nicknames from father's or mother's Christian names are very common in the Isle of Man. Mr. Moore inserts a certain poem which is somewhat amusing:—

"Now, I'll be bail his name is Quaile,
I see it in his face.
As sure as life, exclaimed his wife,
He's something to that race.
Yes, you are right, good dame, said I,
That is my father's name,
Though not the one that I go by,
Nor like unto the same.
I am called by all both great and small,
Bill Homnais-Beg-Tom Moar."*

*Bill, the son of little Tommy, the son of big Tom.

So far as place-names that are of Celtic origin are concerned, Mr. Moore has found that—

Cronk, Cnoc,	occurs as a prefix		76	times.
Glione, gleann,	"	"	39	"
Creg, Creag,	"	"	36	"
Keeill, Cill,	"	"	34	"
Chibher, Tobair,	"	"	21	"
Balla, Baile,	"	"	400	"

As my review of Mr. Moore's book has already extended to an undue length; and as in a paper which I had the honor of sending a few years ago to the Canadian Institute, I discussed the topographical names of the Isle of Man, I shall not now make any minute references to the very instructive portion of his book, which deals with the place-names of his native Island. Scottish Gaels will not be readily disposed to believe that the well-known and expressive word Mull, Maol, Moyle, which occurrs in the Mull of Kintyre, the Mull of Galloway, Mull of Oe, etc., is of Scandinavian origin, and is not after all the pithy Gaelic word Maol, bare or bald. According to Mr. Moore, Mull is the Scandinavian *Muli*, a muzzle or snout, a headland or jutting crag.

Vik is a Scandinavian word that signifies a small creek or bay. Vik is to be recognized in Wick, and in the last syllable of Keswick, Greenwich; and in the forms of *aig* or *ag*, it is present in Greenock, Gourock and many other names in the topography of Scotland. Scottish Gaels who are continually in the habit of employing the term *sgireachd* for parish, are not generally aware that sgireachd, Manx Skeery, is a Scandinavian word, and that it is derived from skera, to cut or divide; the reference doubtless being to the division of Man and of Scotland into what has been long known as parishes.

It might be supposed, that as the Gaels occupied the Isle of Man and the Hebrides long before Danes or Scandinavians began to visit those places, the word to denote a rock in the sea would be Gaelic. It seems, however, that sgeir, the word in question, is Scandinavian.

Mr. Moore has rendered very important service to all who take an interest in the Isle of Man; and to all who find pleasure in examining the records of whatever kind that yet remain to throw light on the days and traditions of Celts everywhere. Mr. Moore's book cannot fail to find a very honourable place among the comparatively few books that are of highest value and that are most highly prized, in connection with the early monuments and character and varied developments of the several divisions of the great Celtic family. The wish is to be devoutly cherished, that some Celts with a large measure of the refined taste and scholarship, and ability and patient enthusiasm of Mr. Moore, will speedily appear to render to their own division of the Celtic family—where such a service is still very much needed—such excellent service as Mr. Moore has rendered to the Isle of Man—a service which ought to endear him to Manx men everywhere, and to make every intelligent and patriotic Celt very grateful to him.

ART IN CANADA TO-DAY.

By J. W. L. Forster.

(Read January 31st, 1891.)

Everything that grows to-day is from seed planted yesterday. Canadian painters have inherited from the pioneers of the profession in this country the legacy bequeathed by our back-woods-men to their sons—honesty and industry, and a hard but fair field for both. During the later years of colonial life Canada has contributed many brilliant names to the art rolls of other lands—the Smillie Brothers, LeClear, Woodward, Rattray, Sandham, Fraser, Walker, Shannon, Peel, Herbert and many more; but in the meantime our own field has been occupied by foreigners.

In Western Canada the names signed upon pictures during the last fifty years have been legion: pilgrims each, as all our fathers were, yet they have helped to plant a stem in the soil of our country from whose vintage we drink to-day. The great majority of visiting artists were British, as their patrons were mostly men whose education and taste were of that careful, academic school. For a time the patronage of art was liberal, but this passed away with the legacies that sustained it, or with the men whose taste and liberality had encouraged the advent of artists of note. But those early days brought to their sons the demands of a busy colonial life, and little opportunity for the culture of the esthetic, and so one by one the artists—birds of passage—disappeared. Paul Kane, the first distinguished Canadian, Sawyer, Fowler, Creswell, Berthon remained. Of these Mr. Berthon's hand alone remains to do honor to the Toronto Law Society in portraits for Osgoode Hall of our distinguished jurists. The Toronto Law Society, inheriting, as many of its members do, the blood and the traditions of the founders of our local commonwealth, has kept alive the spirit of a generous age.

The first, or Upper Canada Art Society, was formed in 1841, the late Mr. J. G. Howard being its chief promoter. It held its first exhibition in the Parliament Buildings, and amongst the pictures shown were a number of valuable paintings by British painters. The Electoral Division Society next assumed the patronage of the fine arts, and during its existence competitive prizes were offered for both professional and amateur artists. James Armstrong was its most active head, the late Col. Denison being its first president. This society merged into the Industrial and

Arts Association, which for years held the gauge of professional merit in the art of the country. In 1873 was formed the first distinctly professional group, known as the Ontario Society of Artists, and which, during these eighteen years has placed annually before the people of Canada the best work of our artists. Two years before that date the Art Association of Montreal was organized, and in 1880 H.R.H. the Princess Louise and the Marquis of Lorne inaugurated the Royal Canadian Academy.

Annual exhibitions of meritorious pictures, aided by an Art Union successfully promoted by the Ontario Society of Artists, under the presidency of Hon. G. W. Allan, have contributed much toward an awaking interest in our country's art ; but equally potent has been the influence of successes achieved by our younger painters in the capitals of Europe in turning the eyes of the people to what is being done at home.

The art of Canada to-day is a mingling of elements. We refrain from mentioning any names of living men, not wishing to discriminate amongst our confreres in any way, although you will not be slow to observe one very natural division, viz.: Belonging to the professional society mentioned are fifty members, of these a half-dozen, certainly not more than ten, are native Canadians. The influence of the old world may be seen in the work of many who cherish still the precepts of their masters. Yet it is due to those who have adopted Canada as their home to say they are as Canadian in the faithful reproduction of the pure glories of our climate as those who first saw the sun in our own sky. Our native artists, who have studied abroad, are very much inclined to paint a Canadian sky with the haze of Western Europe, and our verdure too as though it grew upon foreign soil. Our art is not Canadian.

The French school to-day rules the art of Europe. No stronger evidence of this is required than the catalogue of the Great International Exhibition held in Paris in 1889. The British is the only school distinct from it. Canada furnishes the arena in which the forces of these rival schools contend ; and while the restless dispute continues with little sign of truce, we may at least expect more universal interest in the true ideal to which our painters are looking. When a more intelligent conception of the aim of art is possessed by our younger men especially, it may be discovered that both are near a pure and high ideal, and that rapprochement, not rivalry, would best serve the occasion ; and the union might reasonably be hoped to produce a purer, higher ideal than any yet reached. Material is certainly not wanting, nor motif for art of the grandest order.

The first requisite is for a stronger national spirit. Events are slowly developing this ; and the signs are full of promise in this direction. The

second great need is for a museum equipped with well-chosen specimens of the world's art. Our Government and citizens are establishing schools of industrial and fine art, yet when we would point our pupils to examples of pure art, lo! there are none; and when we would know what art has been, in order to discover what art may be, we must go as exiles and pilgrims to foreign cities, where there is no Canadian air to clear the atmosphere of false traditions, or blow aside the prejudices of antique philosophies: philosophies true enough in themselves, but not adapted to the newer civilization of this continent. We want their history with our hope, their experience with our ambitions; and a museum that gives the best of their art history and achievement will greatly strengthen our hope and give rein to our ambition.

A third need is for capable and generous criticism. There are many men whose discernment and sympathies fit them eminently for the roll of art critic; but as yet journalism has not opened wide the door to advancement in such a specialty. In the meantime, while we wait the advent in Canada of an Albert Wolfe or Hammerton, we declare the unprejudiced impression on the mind of the public to be the fairest test of a picture's merit. No questioning will cast a reasonable doubt upon the claim of an experienced purchaser to first place as connoisseur and critic, freed as he is from the narrowing influences of specialities, which impose limitations upon the judgment of the professional artist. But this question we leave for fuller discussion in a later paper: suffice it for us Canadians in our observation of the nature whose lavish wonders greet the eye everywhere, and of the representations of that nature in pictorial art, we give our independent judgment the encouragement it deserves. False taste will thereby be corrected, and art that is true art greatly encouraged.

BONE CAVES—WITH ESPECIAL REFERENCE TO PREHISTORIC MAN.

By Arthur Harvey.

(Read 19th January, 1891.)

This paper, read at a meeting of the Biological Section, was divided into the following heads :—

1. The cosmogony of the Assyrians, Egyptians and Hebrews compared with that of the Greeks and Romans and of our own time.

2. Various divisions of prehistoric time.

3. Description of cave explorations, and among these :—*(a)*. The Roset cave, by M. Caravin Cachin, translated from the Proceedings of the French Association for the Advancement of Science, 1889. *(b)*. Notes of papers, in the same volume, by M. Theophile Habert, of Troyes; by M. le Dr. Pommerol, of Gerzat, Puy de Dôme; by M. G. Chauvel and Mr. Adrian de Montillet. *(c)*. The bone caves of Gower, by Mr. John Roberts, Swansea (Wales) Institute, 1888. *(d)*. The cave of Gabrovizza, by Dr. Carlo Marchesetti, translated from the Atti del Museo Civico de Storia Naturale, Trieste.

4. The artistic talents of prehistoric man by Dr. Lazarus Popoff. Translated from a French version of the Russian original.

5. The similarity between the habits of stone age men in Europe and (the Indian) in America.

6. Correction, from American analogy, of some current European ideas on this subject.

7. General view of the number, condition and movement of the population in the stone age.

8. Protest against the use of the name "cave-dwellers."

The paper dealt with the last four heads as follows :—

Attention is at once arrested by the remarkable similarity of all the relics of prehistoric man in Europe to these articles which were in daily use among the Indians of this continent when the white man burst upon the American stage. Of these Indian tribes we have survivors, and of their implements of flint, greenstone or diorite, jasper, shell, bone and wood we have in our museum a fine collection. We find lances and

spears, knives, scrapers, drills, axes, borers, pottery, almost identical in shape and size with the European specimens described by the distinguished men above quoted. Even to the ornaments on the bowls this similarity extends. The European manufacture was perhaps a little further advanced. Our whole system of Natural History belonging, indeed, to a somewhat older period than that of Europe, it is not to be wondered at that our indigenous men should have been of a somewhat more primitive type, so that when they came into contact with the European, our aborigines should be inferior in the struggle.

But this striking similarity, extending even to habits and customs, *e. g.*, the cracking of bones for their marrow, the wearing of ornaments of shell, the mixing of red paint for the body, the burning of pottery in the open fire, must surely go further, and one is led to ask if the savants of Europe are justified in applying to these prehistoric people—palæolithic or neolithic; Mousterian, Solutrean, Magdalenian, Robenhausian or others—the general designation of Troglodytes. It is certainly hard to understand with what justice Mr. Caravin Cachin should call the gentleman who is said to have heated flints in fire until some splinters flew off, and then to have further, by knocking off some pieces, made them into cutting implements, an Anthropopithecus. As for the form of the skulls which have been found, it seems now well established that those which appear to be of palæolithic date are long, those of neolithic date a good deal mixed, but usually short; the former being somewhat the larger in cubic contents. People have been led astray and are yet held captive by the old poets, by old legends or traditions, telling of antres vast and the ogres which lived in them. On reflection one must perceive that Europe was inhabited in prehistoric times by a population at least as numerous as was America at the time of its discovery, say by millions, and that this population was in places agricultural, in others pastoral, in others depending principally on the chase; just as we find the Indians to have been here. Those tribes had their wars, feuds like those which existed among our Indians, and they must occasionally have had great chiefs, who would extend their sway over large areas, as some Indian races did, and some of their European successors do to this day. Perhaps incursions would be made by migrating tribes from one land to another, from Asia or from Scythia, as has often been the case in historic times. It seems certain, from the intimate analogy between the aborigines of Europe and of America, that there were considerable movements of population there, every few centuries; race succeeding race, for thousands of years. This view is confirmed by the differences of the types of skull—the long heads or more primitive people having been displaced by suc-

cessive waves of short heads. Languages, too, would follow the analogy of our continent. We may fairly allow to several an area equal to that occupied by, let us say, the Chippewa and its correlated dialects, which would permit of several languages in Europe, as distinct as those of different families of Indians here. The Celtic language is surely a survival of one of these prehistoric tongues, and how much stronger language often is than race may be gathered from the many-complexioned varieties of men who speak a Celtic tongue to-day. The active competition between the races inhabiting Europe in lithic times would naturally produce somewhere a breed of men more powerful than the rest —certainly north of the Alps and the Carpathians, and probably not far from the East German land, ever the breeder of heroes—which would master Europe by degrees and spread even beyond the Caspian, then a most extensive sea, to India. Thus arose the people we call Aryans.

The idea that Europe was a completely afforested country at all times seems an assumption. The aborigines knew the use of fire. Were there no forest fires there as here? Were there no organised methods of making a prairie and of keeping it burned? What mean the ox, the horse, the sheep, if there were no champaign country? It does not even need man to remove the forests. Who can tell what the climate of Europe was in respect to drought when the Caspian was a huge sea extending to and beyond the Aral, including the valley of the Oxus and other Asiatic valleys? Northern Africa, perhaps in consequence of the change in winds which the shrinkage in Asiatic water-areas has caused, is slowly drying up; the great desert is much more arid than it was in Roman times: this may indeed have been the moist region, parts of Europe the dry one. We know that some countries, formerly afforested, are bare to-day—Ireland, parts of France and Italy, perhaps portions of Spain. Some of these have become almost treeless, entirely through the ravages of goats and sheep, especially the former. There must always have been chamois to destroy the forests of one mountain district after another—themselves dying away or migrating as they dimished their own food supply. *En passant* let us observe that no writer on the cave animals of Europe takes any account of a most important point, the probable annual migration of the larger mammals. Winter and summer alternated in these early times as they do now, and, just as the buffalo migrated according to the season, and the deer in Minnesota and Wisconsin still do, being found hundreds of miles further south at one period of the year than at another, so the northern types found in the caves may have been killed or may have died there during their winter migration to warmer climes, and *vice versâ* with southern types.

Long ago, in a paper read before a section of this Institute, the writer combatted the notion that at any epoch one great ice sheet was moving steadily, over mountain and valley, from Muskoka into Pennsylvania, Ohio and New York; holding that when there was perennial ice on our hills it could only follow the slopes. This view has come to be acknowledged, and authorities will now allow some glacier ice to have moved even northward into the prehistoric St. Lawrence, and so on. There now exists in his mind a doubt whether at any time there was a general glacial epoch in the sense the term is used, viz., a reign of cold over the Northern Hemisphere. There has been, it rather seems, a transference from one centre to another of the locality at which precipitation and congelation enough takes place to form glaciers and sheets or caps of ice. If the chief examples are in America to-day, they may at another epoch have been in Europe, and at yet another in Asia. At no time, one begins to think, was there more ice and glacial action over the Northern Hemisphere as a whole than there is to-day. These changes of cold-centres, which are closely connected with changes of areas of evaporation and of aërial humidity, to account for which no nutation or libration of the earth's poles is needed, may have been quite rapid, sufficiently so to have influenced within the time of prehistoric man, the local distributions of types of animals.

One of the most interesting and noted pictures in the Paris Salon of 1889, exhibited in London in 1890, represented a prehistoric man, naked but for a shawl of skins, coming back to his cave with some trophies of the chase. He was meeting at the cavern mouth a fearful sight: his wife (a lovely shape, just like a Paris artists' model of to-day), lying dead at the entrance, and a lion carrying off in its mouth one of his children. This embodied on one canvas many of the ideas European writers have encouraged. We may be certain, however, considering the habits of our Indians (1), that prehistoric man lived in reasonable safety from wild beasts, which would then, as now, rather flee from than attack the haunts of men. Fires, lances, arrows were surely effective for defence and protection. (2). Man of the stone ages was certainly clothed, as a protection against cold; the scrapers and knives were to tan or dress his furs; the drills, needles and other such implements were used to make his covering. With equal certainty he would have garments which would be convenient and would not hinder him in going through the forest, across the plain, or over the mountain slope. (3). The woman was not of the type of the fair skinned Venus de Medici, with delicate fingers unused to toil. (4). The children were not as lovely, except in their parents' eyes, as Raphael's cherubs. With this let us leave the artist.

Lastly let us finish our protest against the appellation given to these men of Troglodytes or cave-dwellers. In a few parts of Europe caves are numerous. In those localities they may have been used as dwellings, for caves can be made very comfortable habitations. They are so equal in temperature, have such lovely views before them, are so secure from fire, flood and cyclone, give such facilities for cleanliness and drainage, that people hold to them as eligible dwellings to this day. We could now multiply cave dwellings almost at will, for we have tools of iron, but the men of the stone ages could not, they had to be content with natural caves, and there never were enough to have served more than the merest fraction of the population. You cannot house the increasing numbers of our forefathers unless you allow them to live under coverings of bark or of skins, probably moveable like those of the Khirghiz, the Esquimaux, the Indians, the South Africans. A spot near a cave was doubtless thought a good place to encamp, the mere shelter of an overhanging ledge would mean comfort, and happy must have been the family in Quaternary times who could establish a right of possession, either for a single season or for several. For a residence of a few weeks at a time, such caves were doubtless convenient; so they would be now for a party of pot-hunters. But if anybody says our ancestors lived continuously and exclusively in caves both dark and wet, on floors reeking with the foulest of smells, which would revolt his senses and destroy his body—let us hesitate to believe him. Was there no rheumatism or phthisis to be feared—no typhoid or malarial fever to be avoided? Possibly the caves may have been used as store houses for a settlement or a group of families encamped near by. During a period of rain or snow or tempest, work could be carried on there, they would be as stores where fuel could be kept dry, and, in summer, carcasses of animals would keep, better than outside. Perhaps the fires were for smoking and so preserving some kinds of meat. During continuous rains the cave might be the temporary kitchen for several families or the whole. This view raises man in all prehistoric epochs, of which we have relics, to a higher plane than that usually assigned to him—so much higher, indeed, as to lead to the belief that in tracing with reasonable accuracy the habits of these ancient tribes, we can find guidance in the local customs of several isolated European districts in this very year of grace—survivals probably from the remotest epochs.

THE OCCURRENCE OF GOLD AND SILVER IN GALENA AND IRON PYRITES.

By R. Dewar.

(Read 29th November, 1890.)

Galena occurs principally in the Silurian and Carboniferous ages. In America deposits occur in the Lower Silurian, Canadian period, and Calciferous epoch, and in the Trenton period, and Trenton epoch. In the Upper Silurian, the Niagara period, and Medina epoch, Carboniferous age, Subcarboniferous period in Missouri. In Europe in Lower Silurian, in the Lower Llandeillo, in Shropshire, in Caradoc formation, in Montgomery and Cardiganshire, in Stage D of Barrande at Priyibram, in Bohemia, in Granada, Jaen, and Sierra DeGador, at the foot of the Sierra Nevadas in Spain.* The deposits at Leadhills, Lanarkshire, Scotland, are also of the Lower Silurian age. Devonian in Devon and Cornwall, in England; Lower Devonian in the Hartz at Andreasburg, and Clausthal; Upper Devonian at Vedrin, in Belgium.

In Carboniferous age, Subcarboniferous period, in mountain limestone in Cumberland, Durham, Northumberland, Yorkshire, Derbyshire and Flintshire, in England; and in county Wicklow, Ireland.

The only deposits of any importance which lie outside of the palaeozoic time are those of Bleiberg and Baibel in Carinthia, Austria, which are supposed to occur in rocks of the Muschelkalk age.

Iron pyrites is found in rocks of all ages from the oldest to the most recent formation.

Galena and iron pyrites are very often found associated with one another.

Both of these sulphides have in some instances been deposited from solution as is attested to by their being found in indurated clay, and in nodules of chalk in clay ironstone from the coal measures; pyrites is even found as galena is, quite commonly as sheets or coatings between the layers of bituminous coal and also on anthracite, as well as pseudomorphs of both animal and vegetable origin.

Galena is found in granite, sandstone, argillaceous and limestone rocks. Its matrix is generally either quartz, fluor spar, baryta, or calcite.

*De Verneul thinks this formation is Triassic.

Galenas occurring in the older crystalline metamorphic rocks are more auriferous and argentiferous and continue to a greater depth than those occurring in limestone, for instance, the galena from the mountain limestone of Cumberland, Derbyshire, etc., although it contains silver is not to be compared with that from Devon or Cornwall, which occurs in metamorphic clayslates or killas; formerly some of the veins in Cornwall produced from 80 to 140 ozs. of silver per ton of ore.

Philips gives in 1874, the statistics as 4,098 tons of lead containing 207,700 ozs. of silver for Devonshire. Before proceeding further, I may say that there is not in existence either galena or iron pyrites in which either gold or silver does not exist. I should mention that I would have incorporated the results of a number of tests made by me for those metals in both these minerals, but Percy has in his Metallurgy of Lead a table, which shows the results of his research in this direction which I do not propose to improve on. When I speak of the presence of these metals, they may either be there as mere traces or may be in such large proportion as to warrant their working; for instance Philips makes mention of the Morro Velho Mine in the province of Minas Geraes, in Brazil, as being the largest and most prosperous in that country up to the year 1863, it having produced since the year 1839, a net profit of one million sterling to its proprietors, but at that time was stopped by the combustion of the timber work, supposed to have originated from the oxidation of pyrites, the workings being on auriferous pyrites. At the present time, quite a portion of the annual production of gold is obtained from pyrites. Veins of pyrites are generally oxidised to a great depth, although in some places they are found normal with merely a surface oxidation; the results are generally Ferric Oxide, $Fe_2\ O_3$. Hydrogen Sulphides, $H_2\ S$, and Sulphur Dioxides SO_2, the excess of these products of oxidation is carried away by circulating surface or subterranean waters, and leaves with the matrix some of the ferric oxide and the greater part of the gold. A good illustration of those facts is the Mount Morgan Gold Mine in Australia, where the ore, if it may be so called, is a siliceous sinter containing gold in a very finely divided state, which has resulted from the oxidation of pyrites, which is proved by the matrix being a siliceous sinter, as the intersticial or honeycombed appearance of same is due to the crystals of pyrites which once filled same having oxidized. In the Lake of the Woods, in Ontario district, especially on the margin of the lake and also in the lake itself, there is a ferruginous earth, which contains considerable gold and which is said to exist in considerable quantities. The gold exists as nuggets as well as in a finely divided state, this also, I believe, has originated from the decomposition of iron pyrites.

Now the gold and silver may have existed in different states preceding the Palæozoic time. It is to be supposd that these metals would be among the first of the elements to condense on the now solid earth's surface or at least long before the gases which are the constituents of water, had reached a temperature favorable for their combining to form that liquid. Now, then, the water when it condensed on the earth would be at a temperature of 100° C. This would certainly take in solution alkaline sulphides and carbonates, provided they were present, and we have grounds to believe that they were. This would attack and dissolve any silica or quartz that it came in contact with, and also in turn attack and dissolve gold. Again, were fissures to open into these seas and mineral or rock matter, we may say gold in a molten state to issue therefrom. The gold would be caused to fly into thousands of small particles which would flatten into sheets when coming in contact with solid bodies, failing to do this, into, small spherical bodies. The gold in this state would be more easily attacked by the foregoing solution; this solution would also dissolve other metals and minerals such as fluor spar and baryta.

I am not exaggerating when I say that it was possible for free chlorine to be present in large quantities in those waters, this, which is the greatest solvent of gold, would certainly attack all it came in contact with. The principal solvents of silver would be chlorine and sulphur solutions. Or, another theory which may either be taken in conjunction with foregoing or independent of it, is, that these metals may have still remained in the metallic state and have lain under superimposed bodies of rock; then during hydrothermal activity, the gold, silver, lead and siliceous rocks would become melted; some of the gold would combine with the silica to form silicate of gold which is a soluble salt, also if a body of sulphur was present, it would combine with the silver, lead and gold to form sulphide. This, then, may have cooled and lain until further subterranean movements caused a fissure to open, or the fissure may have been open during the hydrothermal activity when the fused or liquid masses carried along by aqueous or other vapors would be attracted towards the fissure, as it would be a vacuum compared with the surrounding body of rock and would be deposited on the walls, forming a vein of segregation.

In support of the foregoing, according to Daubree, Lenormant and others, water under pressure at 204° C. will reduce to a pasty condition almost all ordinary rocks. Daubree has shown that all siliceous rocks in the presence of small quantities of superheated water (say about 10%, which is equal to water of sedimentation), become pasty at 204° C., and

426° C. become fluid. Under normal conditions these rocks require from 1371° C. to 1649° C. to liquefy them. If any alkali were present the figures would be considerably reduced. This is termed hydrothermal fusion.

Further, by fusing lead and sulphur together we can make artificial galena, the same is true of silver. We also are able to form silicate as well as sulphide of gold in our laboratories. That silicate of gold exists in nature I was first led to believe by finding that metal in quartz, which, before treatment, had not the least appearance of containing it, and I subsequently found that my results justified me in believing that I was right in my conclusions, and last but not least, as I have before mentioned, that galena veins are very rich in one stratum, but on entering another, provided it has a different composition, they become very poor, thus sustaining my theory that the entire vein matter was originally incorporated in that stratum of rock which forms the wall rock of that part of the strata which has the greatest body of metal.

Again, the gold may have been reduced by erosion to small grains and in time become disseminated through the debris of its disintegrated matrix, thus forming stream gold of which we have examples in our placer mines of California, Australia, Siberia, and other places. Now, were ferrous or ferric sulphate, Fe. SO_4 and Fe_2, 3 SO_4, to percolate through this gravel they would certainly dissolve a large portion of the gold, thus preparing a solution for the formation of auriferous iron pyrites. For the origin of the ferrous and ferric sulphates we have iron pyrites, which is ferric sulphide Fe. S_2, which would lose half its sulphur at a white heat forming ferrous sulphide Fe. S; this, when heated in air would form the sulphide, or else these changes might be brought about by atmospheric agency, as I have mentioned in a foregoing part of this paper.

We will now consider those deposits of galena which occur in non-metamorphic rocks, which are principally in limestone, a good illustration of which are the lead regions of Missouri and Wisconsin, which are not, properly speaking, veins, but have been formed by surface solutions containing the galena and accompanying minerals, namely, calcspar, baryta and chert in solution. The solution was probably an alkaline carbonate or sulphide, as these are the natural solvents of the foregoing minerals. As I before said, these deposits are not to be compared to those which occur in the older metamorphic rocks as regards the amount of silver or gold they contain, but are invaluable as lead producing deposits.

Taking it for granted that the principal body of metal was buried

under superimposed strata of deposited sediments or igneous rock matter, then it is apparent that the material for the nonmetamorphic superficial deposits would have to be drawn from the already formed veins of segregation, and I know of nothing that would influence me to view this negatively as native lead when found, or, properly speaking, as far as has been found, up to the present, has resulted from the decomposition of galena which is undeniable.

To proceed, the galena was not leached from the older veins nor yet carried in solution as sulphide of lead by alkaline sulphide or carbonate solutions, simply for the reason that it is not soluble in those solutions as some geologists would like to believe. Gold is the only sulphide of the metals we are treating of, that is soluble in an alkaline sulphide. Then what possible state would be the most convenient? I have come to the conclusion that the following would be possible, as well as soluble, under the conditions which I shall hereafter give, namely: the lead as chloride, sulphate carbonate, or in metallic state the silver as metallic or chloride, the gold, the chloride, metallic sulphide or the necessary solvents would be alkaline, chlorides, hyposulphites and carbonates; the sulphate of lead and chloride of silver would be soluble in the hyposulphite, the chloride of gold and chloride of lead would be soluble in water; but you will ask me where is there a possibility of any of these solutions existing as well as some of those salts, especially the chloride and hyposulphite solution? Allow me first to remind you that three-quarters of the earth's surface is submerged under what may be called a solution of an alkaline chloride, and as to the hyposulphite solution, active volcanoes always produce sulphur dioxide, Si. O_2, water in the vicinity of those is generally charged with this gas, which combines with it to form sulphurous acid; this again would combine with another atom of sulphur, providing it were present with the necessary heat to form hyposulphurous acid. The following equation would show reaction :—

$$SO_2+H_2O+S=H_2S_2O_3,$$

or the oxygen could be replaced by sodium—

$$=Na_2S_2O_3$$

This may seem a rather complicated process and might be thought unpractical, but when we take into account the vast amount of action exhibited by sulphur springs, we cannot help admitting it to be possible. A good illustration of those springs is one described by Dr. Beck, as existing at Manilus, in the State of New York, which is, according to him, one mile and a half long, half a mile broad, and 168 feet deep; a spring like this would furnish material, allowing us to dispense with the volcano. A spring such as this possibly existed at the bottom of a silurian or carboniferous sea. We have an example of such off the coast

of Florida, with the difference that it is a fresh water spring. As for the salts, galena is oxidized from the sulphide to the sulphate and further to carbonate by atmospheric agency and surface water containing carbon dioxide. In the first place the gold would exist as sulphide in the galena; on decomposition it would be converted into the terchloride by chlorine, as also would the lead and silver to their respective chlorides. But the enormous power of carbon dioxide, assisted by heat, has been overlooked in works on chemical geology, or rather the power, especially of alkaline carbonate. The carbonate of lead being soluble in an alkaline carbonate would be carried along by currents until, perhaps, passing where the waters of a sulphur spring emerged into the sea, or lake, or perhaps the spring burst from the bed of same, these waters being charged with hydrogen sulphides, that gas, or rather solution of gas, would decompose the carbonate as follows:—

$$Pb.\ CO_3 + H_2\ S = Pb.\ S + H_2\ CO_3,$$

thus forming carbonic acid and sulphide of lead. Then the process involved taking the hyposulphite solution as agent would be as follows: The silver having been converted into chloride would be dissolved by the sea or lacustrine hyposulphite solution, it was also possible for a spring of fresh water, such as I have mentioned, to have existed in those seas or lakes; hence, were this solution to pass through this pillar of ascending water, or at least some of it, to be mixed with this solution, then the silver would be precipitated as sulphide, the reaction is as follows:—

$$Na_2S_2O_3 + Ag.Cl. = (Na.Ag.)S_2O_3 + Na.Cl.$$
$$(Na.Ag.)S_2O_3 + H_2O = (Na.Ag)S + H_2SO_4.$$

This may then have come in contact with chlorine, decomposing part of the solution which would again be reduced to silver chloride, and carried along in suspension. In proof of this we have the deposits in Peru of chloride of silver occurring in amorphous masses of sulphide of silver; the chloride of silver also occurs in Peru in the ferruginous rocks called pacos, called in Mexico colorados, and in Cornwall by the Cornish miners, gossan; the chloride of silver of Huelgoet in Brittany, is similar to this, occurring in cavernous hydrated oxide of iron. This pacos is said to have resulted from the oxidation of iron pyrites. Now, it is quite apparent that this chloride was not carried there by the solution containing the constituents for the formation of the iron pyrites, that is in solution, but it is possible that it was carried there in suspension, or that a hot alkaline chloride solution may have had it in solution and coming in contact with the solution, destined for the formation of the pyrites which we may say was cold, or at least at a lower temperature than it; the silver chloride

would be precipitated. Then the vein matter being formed it may have been deposited on the bottom of one of these seas or lakes or the solution carrying along in suspension or solution the vein matter may have issued from the lake by some outlet and may have passed through some fissure which contained detritus. It is certain that a great part of solution would be left to form a vein. We have such veins in the vicinity of Zellerfield and Clansthal, in the Hartz, the gangue being made up of a breccia of country rock which is a clay slate cemented together by baryta, calcite, quartz and carbonate of iron, it is veins of this description that the galena occurs in at that place. In conclusion, allow me to say that we are too quick at condemning processes which, perhaps, seem impracticable in our laboratories, but we should not forget that we are comparing the finite with the infinite ; we must remember that when our Creator, God, had the power to resolve this universe, of which we form a part, from a void ; he certainly had the power to form laws, the beauty of which our feeble conception can scarcely grasp, and that these laws operated at his will. Man is slowly gaining an insight into those laws and is making them his servants in the metallurgical treatment of the treasures of the mine as well as in other branches of science, instances being the chlorination and hypo-sulphite processes. The vast extent of these processes carried on by nature is better understood when we take into consideration such deposits as for instance at Huelgoet in Brittany, where, although the principal ore is an argentiferous galena, yet the deposit which I before mentioned yields 30 oz. of silver per ton as chloride, and the pacos of Peru, although having been worked for two centuries, at the beginning of this century had not been penetrated to a depth of 100 feet.

NOTE.—In confirmation of the statement in regard to sulphide of gold in this paper, I may say that three days after reading same I was examining a piece of quartz containing pyrites, when, on turning the quartz in my hand, I noticed a dark powder in a crevice which appeared to be plumbago, but on close inspection, and on making an analysis, I found it to be a ferrous sulphide Fe, S, containing sulphide of gold ; the pyrites proved to be iron pyrites containing arsenide of nickel and traces of gold ; the vein from which it was taken had walls of diorite.

REFORMS IN TIME RECKONING.

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(Read 21st March, 1891.)

It is only within the last fifteen years that special attention has been directed to the unsouud principles, the untenable theories, and the curious old usages which still in many quarters prevail with respect to time, its measurement and notation. In spite of the advance in science in other directions, which makes the incongruities in question the more remarkable, we have remained until now rooted in observances which cannot be defended on any rational or scientific ground. We do not suppress our ridicule at many ancient customs which at the present day appear to us absurd ; nevertheless we remain blind to the fact that some of our practices in the reckoning of time, are not less irrational, and are based on theories which cannot be sustained.

The three great divisions of time, with which we are most familiar, are the year, the month, and the day : the latter is the smallest measure of time revealed to us in nature, and is dependent upon the diurnal rotation of the earth. Although the subdivision of the day is of extreme antiquity, at one period in history hours were unknown. The word hour is not found in Plato or in Xenophon. It is first met with at the period of the Macedonian rule at Athens. In the early literature of Greece, the Hours (Horai) are mentioned, not as the divisions of the day, but as the goddesses of the Seasons, as maidens of beauty bearing the products of the earth, and attendant upon Venus as she rose from the sea.

With a primitive people, the crowing of the cock was a means of making known the early dawn ; and the position of the sun in the heavens enabled mankind to estimate the passage of time during the hours of sunlight ; the progress of night was determined by the position of the stars. By such rude means a rough approximation was obtained of known intervals during the passage of night and day.

The separation of the day into two series each of twelve hours took its origin long before the Christian era. The Arcadians counted the night from sun-set to sun-rise by a subdivision of twelve parts determined by the observed stars or groups of stars which appeared at

intervals in the eastern horizon, and the intervals were thus denoted with proximate accuracy. By analogy the day from sun-rise to sun-set was similarly subdivided; hence the division of the diurnal period embracing day-light and darkness, into two portions, each of which was subdivided into twelve hours. The modern practice differs from ancient usage only in the initial points of division. We reckon from mid-day and midnight instead of from sun-rise and sun-set. The ancients had an absolutely distinct reckoning for the night, and another for the day, and they employed for the duty of observation during these periods two distinct classes of watchers.

Both in Greece and Rome "gnomons" were erected in open ground for the public benefit, the length of the shadows of which denoted the several hours. Magistrates were charged with the duty of watching the shadow, and announcing in a loud voice the moment of mid-day, morning, and evening. A few persons of wealth maintained their private gnomons with slaves to watch the progress of the shadow, and at intervals to announce its length. It is generally supposed that the great obelisks of Egypt, examples of which still remain, were the clocks of the ancients. One fact was early noticeable, that the gnomon or obelisk, whatever its length, and whatever the season, cast its shortest shadow at an invariable period of the day, and thus mid-day naturally became established at an early date as an important point of time.

An advance was made in the art of measuring the passage of the sun by the introduction of sun-dials, by which a greater degree of precision was obtained. Herodotus tells us that the concave dial and the ordinary sun-dial were brought from Egypt, with the division of the period of direct sunlight into twelve parts, all of which "the Greeks learned from the Babylonians."

Obviously the hours, being each a twelfth part of the two intervals between sun-rise and sun-set, varied in length in the different months. Throughout the temperate zone, hours determined on this principle would constantly vary. In one half the year the hours of the night, in the other half those of the day, would be the longest. Only twice in the year, that is to say, at the equinoxes, would the hours be of uniform length. In some parts of the temperate zone the hours in summer would be, under this system, double the length of the hours in winter, and *vice versa*. As the reckoning began with sun-rise and sun-set, these epochs coincided with the twelfth hour of the previous half-day. Mid-day and midnight each would be the sixth hour of the respective days and nights.

Gradually mechanical contrivances were introduced to overcome the

impossibility of observing the time by the sun or stars during cloudy weather. The first mechanical means employed was the flow of water, drop by drop. Mechanisms of this kind named by the Greeks clepsydras, were of various forms; in one class the flow of water was weighed, in another the volume was measured. The clepsydra was introduced into Egypt at the time of the Ptolemies; from thence it found its way to Greece and Rome.

In these mechanical movements, and in others which followed in later years, it became necessary to introduce complicated contrivances to mark the variable length of the hours as the seasons advanced. Such is the invincible power of habit that it exacted a continual change in the movement of time-keepers in order to secure a notation of the unequal hours. To denote these ever-varying intervals by machines of regular motion, demanded all the inventive powers and skill, which the pertinacity of human ingenuity could call forth, to meet this requirement. It will readily be understood that the ancient water clock was a great and cumbrous contrivance, possessed only by royal personages, or men of large wealth, and was regarded by the people of that age as a product of much intellectual culture, and an evidence of the advance of civilization.

In the cloisters, the monks contrived to denote the passage of time by the consumption of oil in lamps graduated for the purpose; elsewhere by the burning of candles, upon the wicks of which were placed a series of knots at calculated intervals to mark periodic duration. In course of years sand glasses were introduced, some of which were regulated to be reversed at the end of each half-hour; in which case it was indispensable to have watchers continually in attendance to turn them forty-eight times during the twenty-four hours.

The great defect of all these contrivances was, they had no principle of continuity, and incessant watchfulness had to be observed. An effort was therefore made to supersede the dropping of water, the consumption of oil, the running of sand, and the burning of tapers, by having recourse to suspended weights, and the introduction of wheelwork which should move with regularity, and chronicle the hour. In 1288, one of these machines was installed at Westminster Hall, which drew forth the admiration of the people of London. Half a century later a similar mechanical combination was erected at Dover Castle; about this date wheelwork clocks were placed in the Church of St. Gothard, at Padua, and at different points in Europe.

In every one of these complicated mechanical contrivances the exigencies of "use and wont" had to be taken into account. Public opinion

of those dates would not countenance the adoption of hours of uniform length throughout the year. It was exacted that hours of the day and night should remain distinct, and should vary with the change of seasons. So late as the fifteenth century this strange usage of counting the passage of time by hours of unequal length remained in force. Gradually its absurdity became apparent, and the practice was introduced of allowing the clocks to continue their movements at the same rate night and day, commencing the reckoning as before at sunset.

Although the hours were no longer required to be variable in length, the commencement of the day at sunset continually varied with the seasons. The necessity therefore remained of moving the hands of the clock forward or backward nearly every day, or as it frequently happened the assumed error was allowed to accumulate until it reached a quarter of an hour. The total error in the latitude of Greenwich in any half year was about four hours and a half; an error which was reversed each half year, as the seasons changed. The same practice prevailed generally throughout Europe, and the total discrepancy was greater or less than four and a half hours according to latitude.

This continual adaptation of the hands on the dial was known as "the leap of the clock" (*sauter l'heure*), and however perfect the mechanical arrangements, it was in vain, under such a system, to look for precision or uniformity of reckoning.

The incessant interference, the daily application of thumb rule to move the hands sometimes forward, at other times backward, an operation termed "regulating the clock by the sun," to meet the daily changing period of sunset, required so much attention that the ingenuity of skilled men was directed to obtain some means of effecting the changes automatically. M. Houzeau, in a lecture before the Royal Belgium Geographical Society, March, 1888, remarks on this point:—"Never was human ingenuity expended upon any subject so irrational and of such little merit. But habit which had lasted for centuries was at stake, and habits never reason, they exact." Towards the end of the last century these wonderful machines with automatical complications for pushing forward or retarding the hours were objects of admiration in most of the capitals of Europe, and so late as 1806 an honorary distinction was conferred by the French Emperor Napoleon I., on the inventor and maker of a clock possessing the proper increment needed to change with accuracy the hands on the dial every day at all seasons.

Some years before this date, the question was being asked, what advantage results from having a daily change in the initial point of the hours, why not have uniformity, summer and winter, as well as

night and day? The spirit of enquiry eventually resulted in the introduction of what we now call "mean time," but to effect the change was a matter of great difficulty. In the words of M. Houzeau:—"It was a greater revolution than we are now capable of imagining. There was between this uniform time, which we call "mean time," and the time of the people or of the sun, sometimes the difference of a quarter of an hour. Out of this divergence the populations created a scarecrow at which we are forced to laugh. The mid-day by the sun, or the middle of the day, will no longer, they said, accord with twelve o'clock. Tradesmen, day laborers, will be bewildered and their work disarranged. The forenoon will be sometimes longer, sometimes shorter, than the afternoon. Bakers deceived by the clock will no longer be ready in time, and the people will be in want of bread. I in no way exaggerate, but is not this the history of all reforms? And what did the fears amount to? We have to-day "mean time," without the immense majority of our contemporaries having the least idea that any other notation was ever followed."*

The introduction of mean time into common use was only effected after much opposition. It took its origin in Geneva in 1780, and slowly made its way. In London the variable hours ceased in 1792. It required another eighteen years to overcome the old custom in Berlin, and it is difficult to believe that Paris did not renounce the daily alteration of its clocks until 1816.

We smile at these practices, now happily no longer prevailing, which came down from antiquity, and wonder at the persistency with which they were clung to, even after their absurdity became recognized. Another generation may perhaps laugh at those living in this century for adhering to customs not less open to ridicule.

What reason can we give for using the double series of hours, repeating one to twelve in each half of a single diurnal period; a practice which originated in primitive times, the purpose and significance of which have long since been forgotten? Who in this railway age would think of regulating the movement of trains by the shadow of the sun during the day, or by the progress of the stars during the night?

Again there is a general belief throughout Christendom that Sunday is simultaneous over the world. What would the rigid Sabbatarian say if told as a matter of fact that Saturday extends into the middle of Sunday, and Monday begins when Saturday ends? and while this is actually the case, Sunday itself extends from the end of Friday to the first hour of Tuesday, ranging over forty-eight hours? Further, that the same ano-

* Translated from Houzeau, Histoire de l'heure, pp. 182-3.

maly is common to each of the seven days of the week? Again, "local time" is a familiar expression, but it is entirely incorrect. There is no such thing as local time. The expression "local time" is based upon the theory that time changes with the longitude; that each meridian has a separate and distinct time. Let us follow this theory out. Take a hundred or a thousand different meridians. All meridians meet at two common points, one in each of the hemispheres, the poles, so that at each of these points we would have a hundred or a thousand different "local times." This only requires to be stated to establish the impossibility and absurdity of the theory that in nature there is a multiplicity of "local times." Why do we use the terms "astronomical time," "solar time," "sidereal time," "nautical time," "mean time," and so on? Expressions which imply plurality of the conception which we call time? Let us endeavor to make clear that these terms are misleading, by asking what time actually is.

It is less difficult to say what it is not, than to define what time is. This much we know, it is neither fluid nor solid; it has no body or spirit; it is not distinguishable by any of the senses; we can only form a conception of time by its passage; it is nevertheless a reality with an infinite past and an infinite future. Continuity is its chief attribute; it may be likened to an endless chain composed of an infinite number of links, each link inseparably connected with its fellow links, while the whole moves onward in unalterable order. Unlike material bodies, time cannot be divided into separate parts, to constitute two or more distinct portions or classes of duration, in the sense in which solids and fluids can be divided; it may be likened to a stream diffused throughout space, which uninterruptedly flows uniformly onward, and more than one such stream is inconceivable. If time cannot be divided into separate parts, it may be divided in another sense, but the divisions are not interchangeable; it is not possible for any one division to be displaced, or any two divisions to be transposed; divisions of time cannot like books in a library be classified and arranged in separate shelves, or be changed from place to place; they cannot as soldiers in a regiment fall out of position in the ranks; all divisions and sub-divisions of time remain in an unbroken line, they advance in single file, never to pass out of consecutive order. Time remains uninfluenced by matter, by space, or by distance; it is universal and essentially non-local. There is only one time, and its divisions can never be found side by side; they only follow one another. Different times, so-called, are merely divisions of the one time; they do not co-exist, but are parts of an inseparable whole. Time is an absolute unity, the same throughout the entire universe, with

the remarkable attribute that it can be measured with the nicest precision.

If we accept the cardinal idea running through this definition that *there is one time only* we will find ourselves on solid ground, and we may proceed to build up on the fundamental principles of unity and unbroken continuity a scheme of reckoning to meet all reasonable demands which may be made upon it, in this and succeeding generations. The problem would be easier of solution were there no existing customs to overcome, and we had to begin *de novo* to establish the best means of accomplishing the desired purpose.

As we are circumstanced in the world's history, we have to accommodate the reform of to-day to such of our inherited usages as are not at variance with essential principles, or do not materially affect their application. If, for example, circumstances admitted, we might with advantage introduce the decimal system as a notation to be followed, but we already use the duodecimal combined with the sexagesimal division, and force of habit seems to require, that we should, as far as possible, adhere to the existing system in this respect, at least so far as it is not at variance with sound principles and the general convenience. It is obviously indispensible that we should refrain from any meddlesome interference with confirmed usages, or suggest changes not manifestly called for.

The advance of civilization during the past half century has produced entirely new conditions in human life. Steam and electricity applied to communication by sea and land have done much to obliterate distance, and bring all nations, so to speak, within one neighborhood. Through force of circumstances, therefore, we are obliged to take a comprehensive view of the entire globe in considering the question of time-reckoning. It is no longer possible to limit the subject to a narrow and sectional aspect. The progress of the age demands that we should not confine our view to one limited horizon, to one country or to one continent. The problem presented for solution to the people of both hemispheres is to secure a measurement of the one universal passage of time common to all, which shall be based on data so incontrovertible, and on principles so sound, as to obtain the acceptance of the generations which are to follow us.

To effect any measurement there are two essentials; first, a starting point or zero; second, a scale or a unit of measurement. The Washington Conference of 1884 has determined both a zero and a unit. The zero is the instant of mean solar passage on the anti-prime meridian

which is 180° from the meridian of Greenwich. The unit is the smallest and most available measure of time which nature presents to us; the period occupied by a single rotation of the earth on its axis, and is denoted by two successive solar passages on the zero meridian.

The "universal day," as defined by the Washington Conference, is actually the time unit, but the term "day" is unfortunate and misleading.* A "day" is always associated with sunlight and darkness, and is in fact a local and superficial phenomenon. Every separate meridian which can be laid down on the surface of the globe has its definite day with the accompanying and distinct sun-rise and sun-set in each case. It is important to disassociate the normal unit, the standard measure of time for the world, from our ordinary conception of the day. In order to do so and make clear the fundamental idea of unity of reckoning, it will answer our purpose to find a point of reference equally related to the whole globe. The centre of the earth is this one point identical in relation to every spot on the surface. If we could directly communicate with a standard chronometer at the centre to regulate clocks in all latitudes we would have the means of obtaining the perfect unification of time-reckoning the world over. Is there no other point where we could establish a common standard? Is not the axis of rotation which passes through the earth's centre common to the whole earth, and would not any point on this axis furnish the position we are in search of? Let us accordingly take one extremity of the axis, the north pole, and in imagination place ourselves in observation at this point, free from local influences. We would find no sun-rise, no sun-set, neither east nor west, every radius of direction would be identical. We would have nothing given but the position of the meridian establishing the time-zero; from this starting point suppose we divide the horizon into a series of arcs, each of fifteen degrees, making the total number of arcs twenty-four, and through the end of each arc we draw a meridian. The passage of the sun over the zero meridian will indicate the commencement of the time-unit which, according to the usage of centuries, and the decision of the Washington Conference, is divided into twenty-four hours. At the end of the first hour the sun will be over a meridian which may appropriately be termed the *first* hour meridian; at the end of the second hour the solar passage will have advanced to another meridian, which may be distinguished as the

* The question of a proper name for the "time unit" has been considered by the Royal Society of Canada at its May meetings in 1890 and 1891. A time nomenclature committee has been appointed and some progress has been made in this, as well as the question of distinguishing the hour meridians.

second hour meridian; at the end of the third hour it will be on the *third* hour meridian, and so passing over the whole twenty-four.*

This mode of distinguishing the hour meridian, possesses peculiar advantages which will be made plain on reference to the diagram, showing a projection of the northern hemisphere. The figures around the circumference indicate the new meridians numbered as described. The same figures indicate the twenty-four hours into which the world's standard unit measure of time is divided. The motion of the earth on its axis brings each hour meridian in succession to its solar passage, and a complete coincidence is obtained between the hour meridians and the hours of the world's standard. For example, when the solar passage is on hour meridian number 12, it will be 12 o'clock; when on hour meridian number 17, it will be 17 o'clock, and so on for every meridian. Throughout each day the solar passage becomes the index of time common to the world.

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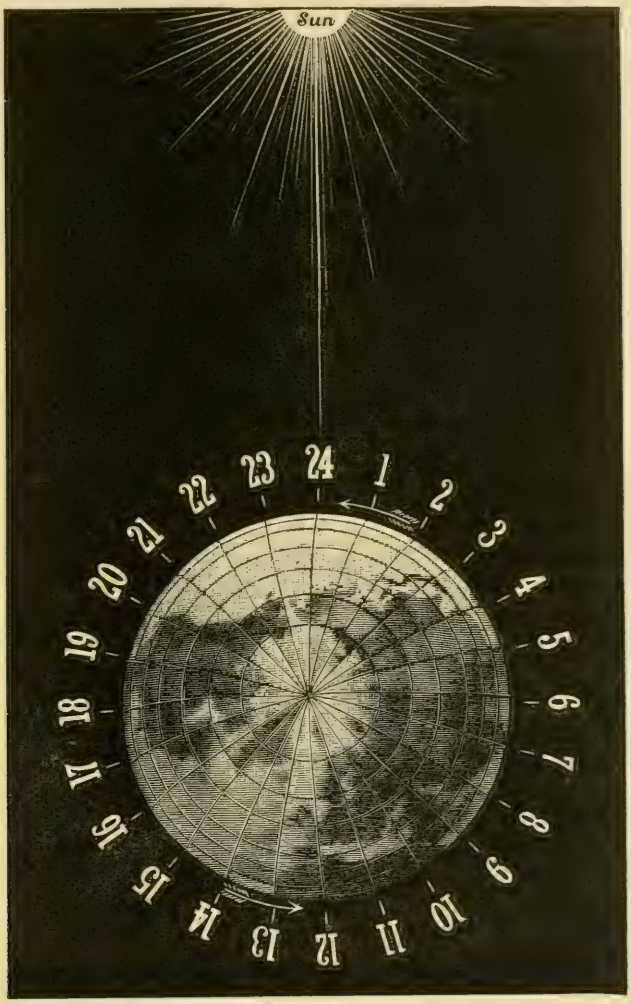
* The time nomenclature committee of the Royal Society of Canada has had under consideration the best mode of distinguishing the hour meridians. This committee reported, May 29th 1891, in favour of using numbers in preference to geographical or other terms, so as to obviate all confusion, numbers having the same precise meaning in all languages and being equally appropriate in both hemispheres. The committee likewise expressed the opinion, which was unanimously endorsed by the society, that the hour meridians should be numbered in consecutive order from the anti-prime meridian as zero, following the apparent motion of the sun towards the west, that is to say as follows, viz:

Anti-Prime Meridian	180° East and West Longitude		Zero	—0—*Zero.*
Hour Meridian	165° East Longitude, numbered		One	—1—*Unus.*
"	150°	" "	Two	—2—*Duo.*
"	135°	" "	Three	—3—*Tres.*
"	120°	" "	Four	—4—*Quatuor.*
"	105°	" "	Five	—5—*Quinque.*
"	90°	" "	Six	—6—*Sex.*
"	75°	" "	Seven	—7—*Septem.*
"	60°	" "	Eight	—8—*Octo.*
"	45°	" "	Nine	—9—*Novem.*
"	30°	" "	Ten	—10—*Decem.*
"	15°	" "	Eleven	—11—*Undecim.*
"	0° Prime Meridian	"	Twelve	—12—*Duodecim.*
"	15° West Longitude	"	Thirteen	—13—*Tredecim.*
"	30°	" "	Fourteen	—14—*Quatuordecim.*
"	45°	" "	Fifteen	—15—*Quindecim.*
"	60°	" "	Sixteen	—16—*Sedecim.*
"	75°	" "	Seventeen	—17—*Septemdecim.*
"	90°	" "	Eighteen	—18—*Octodecim.*
"	105°	" "	Nineteen	—19—*Novemdecim.*
"	120°	" "	Twenty	—20— *Viginti.*
"	135°	" "	Twenty-one	—21—*Viginti unus.*
"	150°	" "	Twenty-two	—22—*Viginti duo.*
"	165°	" "	Twenty-three	—23—*Viginti tres.*
Anti-Prime Meridian	180° East and West Longitude		Twenty-four	—24 or *Zero.*

The Royal Society of Canada has by a unanimous vote recommended that the nomenclature proposed for the hour meridian be brought to the attention of scientific men and sister societies throughout the world, with the view of obtaining general concurrence.



Reference to the diagram will make it clear, that we possess in the earth itself, with the sun as the index, the infallible means of measuring time with precision for ever. The diurnal rotation of the earth is marked by perfect uniformity of movement, and we know of nothing more certain, than its continual recurrence to a given starting point within established intervals. Here, then, we have a great chronometer, which can never fail us, common to the world. Here, provided by

nature is a standard for the measurement of time, which humanity in all places and in all ages may accept.

The direct connection between each locality on the earth's surface and the world's standard chronometer is through the hour meridian. It is plain that when any given hour is indicated by the solar passage, the sun will be vertical over every part of that meridian in both hemispheres. Accordingly, the earth's surface being divided into twenty-four sections or zones, each extending seven and a half degrees on each side of its hour meridian, we obtain the means of establishing universally the one reckoning by the common standard. This has been termed the "hour zone system." By its use, the difficulties which have been referred to are overcome without any violent departure from our inherited ideas, and the exacting customs entailed upon us.

The unity of time is indisputable. Looking forward a few years, unity of notation may become indispensable; meanwhile, the present aim and object is to obtain in all civilized countries uniformity of reckoning. If a common notation were at once attempted throughout the world, it would come into direct conflict with the habits and customs which have everywhere prevailed from the first dawn of civilization. The hour zone system, while furnishing the easy means of transition to one notation, provides a way by which correct principles may at once universally be applied, and uniformity in time-reckoning substantially secured.

The hour zones theoretically extend seven and a half degrees of longitude on each side of the hour meridians, but an arbitrary enforcement of this limitation is by no means essential. The boundary line of contiguous zones must be governed by national, geographical, or commercial considerations, as expediency in each case will dictate.

The principles which underlie the hour zone system are: (1) that on the passage of the sun on any hour meridian it is held to be twelve o'clock (noon) throughout the zone to which that meridian belongs; (2) that the notation in each zone is directly connected with the common standard unit of the world by an established relationship. It is obvious, that if the notation in the several zones be thus connected with the world's standard, there will be a complete and systematic identification in the notation of each of the twenty-four zones. There will be differences, but the differences will in every case be known, the gradations being the invariable multiple of one hour. Throughout the globe there will be complete identity in the minutes and seconds. For example: when the reckoning is described in the tenth zone as 6 hours,

25 minutes, 30 seconds, in the eleventh zone it will be 5 hours, 25 minutes, 30 seconds, in the twelfth zone 4 hours, 25 minutes, 30 seconds, and so on, each successive zone differing in its notation by an exact hour. Thus it will be clear that the system is based on the one reckoning, according to a common standard of measurement and reference. The only departure from complete uniformity will be found in the nomenclature of the hours; but the numbers of the hours being governed by the numbers of the hour meridians, reference to the common standard will at all times be simple and direct.

The relationship established by this system, between the reckoning in each zone or section of the globe, and the world's standard, may for convenience be reduced to the following simple formula:

Let H be the number of the hour meredian, then

(1) In the zone of hour meridian 12 (corresponding with the meridian of Greenwich) the notation of the hours will agree with the world's standard.

(2) In all EAST Longitudes (zones to the east of hour meridian 12) the notation will be in advance of the world's standard.

Hours FASTER = 12—H.

(3) In all WEST Longitudes (zones to the west of hour meridian 12) the notation will be behind the world's standard.

Hours SLOWER = H—12.

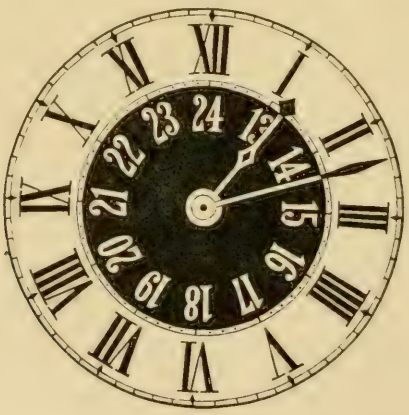
The number distinguishing an hour meridian will be the key to the notation in the zone of that meridian. The world's standard will be the mean of all possible zone notations.

The hour zone system has now been in use throughout North America for seven years, and in the Japanese Empire for two years. In England, Scotland, and Sweden, the reckoning is in accord with this system. In Austria-Hungary, Germany, and Belgium, by all accounts it is on the eve of adoption. Wherever it has been adopted, it has resulted in giving the greatest satisfaction; the hours recorded by the clocks are everywhere indicated at the same moment; the only difference is in the number by which they are distinguished in the several zones, with that simple exception, minutes, seconds, and every sub-division of time are synchronous.

Another important, although secondary, reform in regulating the reckoning of time throughout the world, is to abandon the division of the day into halves, these halves being sub-divided into separate sets of hours, known as *ante meridian* and *post meridian*. The proposal is to follow the recommendation of the Washington Conference with respect

to the "universal day" (the world's standard unit of time), which the representatives of all nations present determined, should be sub-divided into a single series of hours numbered from zero to twenty-four. The old custom of counting the day by halves has no more to recommend it than dividing the month into halves, a custom which prevailed in Europe before the fifteenth century. Each month of thirty days was divided into equal parts; each month of thirty-one days into a first part of sixteen days, numbered one to sixteen and distinguished by the word *intrante*, the second part of fifteen days numbered in reverse order, fifteen to one, and known as *restante*. But the division of the day into two sets of twelve hours similarly named has positive disadvantages. In these days of railways the possibility of error is increased by it, in itself no light consideration. In the printing of time-tables, or the giving and receiving of train orders, a misprint or misapprehension of a single letter may cause a mistake or mishap; while the degree of uncertainty which in some cases exists, may lead to confusion, and confusion not infrequently results in consequences more or less serious.

The twenty-four hour notation, so called, removes all doubt, and assures safety. The change from the old custom is easily effected, and without danger. Experience has established that timepieces now in use can readily be adapted to the new notation by inscribing on their dials the afternoon hours in some such manner as the diagram indicates.



Hours having a lower number than twelve are known to belong absolutely to the first part of the day; those having a higher number to the after part. The new notation has been widely used in Canada for four or five years, being exclusively employed for railway purposes in the Provinces of Nova Scotia, Prince Edward Island, New Brunswick, Manitoba, Alberta and British Columbia, and in portions of Ontario

and Quebec. It has quite recently been brought into use on all the railways within the Indian Empire and in China. Everywhere it gives the greatest satisfaction. According to a report submitted at the last annual meeting of the American Society of Civil Engineers, there is every prospect of the new notation being adopted on all the railways of North America at an early day. The same report points out that while at the beginning of 1890 it was in use on less than 4,000 miles of railway, before the year closed the twenty-four hour notation was permanently adopted on more than 20,000 miles in America and Asia.

If we consider the length of time exacted and the difficulty of effort to effect some of the reforms in time-reckoning to which allusion has been made, we may well be surprised that so much has already been accomplished towards this final reform. Only a few years ago the proposal to interfere with the time honored usage, whatever its necessity, was received with derision. It soon became obvious, however, to men of broad and advanced views, that great changes in time-reckoning and time notation would soon be demanded as requirements of the new conditions of human life. The Congress of the United States intervened, and on the invitation of the President a conference of all nations was held at Washington in 1884, when the subject was first authoritatively considered. Congress is again taking action, by entertaining a measure recently introduced to legalize the changes already effected and contemplated.

In 1878, when an earnest attempt was made to bring the subject of "time reform" to the attention of the British Association for the Advancement of Science, it was looked upon as pure utopianism, and a hearing for it could not be obtained. To-day the British Government, ordinarily conservative in ancient usages, has forwarded to the Governments of every British possession around the globe, the recommendations of the highest scientific authorities in its service "with a view to the adoption of the Hour Zone system in reckoning time generally, and of the 24 hour notation for railway time tables."

There have been other reforms besides those mentioned in the foregoing pages; the most memorable of which were those of Julius Caesar, B. C. 46, and of Pope Gregory XIII., A. D. 1582. The former introduced regulations respecting the division of time which were rendered necessary by the confusion which then prevailed. The latter corrected certain defects which had crept in, in connection with the Julian Calendar, and established new rules of intercalation, regarding the period known as leap year or "Bissextile." The reform of 1582 took effect in some parts of southern Europe soon after it was decreed, but so

much opposition was offered to it by popular prejudice, that one hundred and seventy years passed before it became law in England; and this reform has not yet reached Russia, where they still adhere to the old style.

The Astronomer Royal of Great Britain has pointed out how different to the past, recent experience has been. In evidence that the claims of truth and utility are now recognized to be above error and confusion, he draws attention to the breadth of view of the managers of the American railways, who were so largely instrumental in introducing the Hour Zone system, a reform calculated to benefit the world in all future ages. In 1886, at the Royal Institution, London, he paid them the well-deserved tribute that "they rose above national jealousies, and decided to have their time-reckoning based on the meridian which was likely to suit the convenience of the greatest numbers, thus doing their utmost to promote uniformity of time throughout the world, by setting an example of the sacrifice of human susceptibilities to general expediency."

A CONSIDERATION OF SEWERAGE SCHEMES.

By L. J. Clark.

(Read 7th March, 1891.)

The title of my paper will lead me to consider the subject under three heads.

I. A general survey of the position of sewage affairs in various parts of the world, particularly in England and Germany.

II. An elucidation of a gravity scheme for Toronto; and

III. Some general defects in sewerage works, and also some weak points in the scheme at present before the city, if time will permit.

A member of the Institute placed in my hands a work on Sewage Disposal, by W. Santo Crimp, assistant engineer of the London County Council, England, with the remark that my tastes ran more in that line than his, and that I might extract something from it that would be of interest to at least some of the members of our society. I have found the book to be one of very great interest, as it contains the very latest information on the subject, having been issued but a few months.

By adopting a schedule relating to the details of sewage disposal, he is able to give the particulars of about forty towns and cities in England in very little space. The information relates, under the head of Sewage Treatment, 1. To *mode* of *disposal*, viz., by precipitation, filtration, irrigation, and direct discharge into large bodies of water. 2. To chemicals used, such as lime, alumino ferric or sulphate of alumina, &c. 3. Annual production of sludge in tons. 4. Disposal of sludge. 5. Tanks, precipitating, continuous or intermittent. 6. Acreage of land used. 7. Years in operation. 8. Closets, whether water closets, pails, privies, or ashpits. 9. Sewage flow every twenty-four hours. 10. Gallons per head. 11. Disposal of manufacturing waste.

Of course all these questions are not fully answered in every case; for instance under the head of Disposal of Sludge, twenty-four answers only are given, as follows:—Given away, 5. Dug into the ground, 5. Sold, 12. Burnt in destructors, 1. Pay for removal, 1.

This throws considerable light on the subject of utilization of sludge for manurial purposes. Many look upon the discharge of crude sewage into large rivers or other bodies of water as being an inexcusable waste;

but the statistics Mr. Crimp has been able to gather do not show that it is possible to obtain much profit from it. He says the manurial value of sludge is now admitted to be very low, and except in a few isolated instances sludge is recognized as a material to be got rid of in the cheapest manner. Furthermore, if it possesses a commercial value, commercial men may be safely relied on to utilize it. They can have the sludge for nothing, in any quantity. Let them take it and deal with it as they will.

Just here let me interject a somewhat novel proposition made with regard to the disposal of the London sewage, viz., by *steamship carriage.* It is intended to convey to sea, in specially designed steamships, the sludge produced from the London sewage. The great advantage of the method is that the sludge will never be seen. Precipitated in covered reservoirs, transmitted from these precipitating tanks to special settling tanks, from thence pumped into the sludge vessel and discharged far from land, the sludge will disappear in the most speedy, cleanly and safe manner that can be devised.

The objections to this system are threefold. 1. Waste of valuable manure. 2. Possibility of nuisance on the coast. 3. Delay in transit by fogs and stress of weather. The first objection has already been answered, commercial men would take care of it, etc. The second objection as to the possibility of nuisance on the coast is a mistaken one. Examine the point closely. Some 3,000 tons of settled sludge, equal to about 150 tons of organic matter, will be discharged per diem, under water several miles from the coast. This will not be discharged at one spot, but be spread over some thirty miles. Assume that the discharge from one vessel holding 1,000 tons, equal to 50 tons of organic matter formed a track when diffused in the water four yards deep by four yards wide, and ten miles in length; what would be the quantity of organic matter in that polluted line of water? Only 16 grains in each gallon. Given a gallon of water containing 16 grains of organic matter situated say, ten miles from the shore, and in a strong tidal way, how much offence will be given, after diffusion, oxidation, the feeding of fish, &c., have acted their part by the time it has reached the coast, if it ever does reach it? I think the objection is satisfactorily answered.

The third objection, delay by fogs and stress of weather is a trivial one. An increase in the capacity of the sludge settling tanks with reserved steam power, which must be provided in any case to guard against breakdowns, will effectually overcome this difficulty. If the whole of the enormous naval traffic of England can be carried on as it is, with almost mathematical precision, surely the carriage of a few

thousand tons of sewer sludge to the channel can be as readily accomplished.

While it is thus clear that in the case of the metropolis the conveyance of the sludge to the sea is the only available remedy, it by no means follows that under other circumstances, and where local conditions are favorable other systems are undesirable. Each case must be dealt with on its own merits, and according to local requirements.

I believe it was at one time the intention of the City Engineer to recommend a somewhat similar scheme for the City of Toronto, for a temporary relief, but no doubt the winter season here would interfere with such a scheme.

Reverting once more to the schedule we learn the average amount of sewage per head daily in these forty towns. It amounts to a trifle less than forty gallons per day. This is of importance, and will be referred to later on, as the size of the sewers should be proportioned to the amount of sewage they are intended to convey.

Under the head of chemicals used, the prevailing materials are lime and sulphate of alumina or alumino ferric. They are found to produce the best results when used in the proportion of 7 grains of the former to 5 of the latter per gallon. The lime is usually applied in the form of milk-of-lime, but better results are produced by using the lime in solution. Great care must be taken to apply just the proper quantity, and have it properly mixed. Machinery more or less complicated is used for this purpose, which it would be quite out of place to attempt to describe in a paper of this nature.

Under the head of acreage I find that on an average one acre of land is required for about 125 persons where sewage farms are established. Thus for Toronto would be required about 1,600 acres, and of course a corresponding increase would be required as the population increased. But even this is considered a low estimate. In Germany 100, and even as low as 75 persons to the acre is recommended. It is admitted by persons in charge of sewage works that the longer land is used for sewage disposal the more it becomes clogged, and the number per acre requires to be reduced.

Comparatively full descriptions of the sewage works of a number of towns and cities of England are given in Mr. Crimp's book, among which are the following: Doncaster, Croydon, Bedford, Dewsbury, Merton, Swanwick, Chiswick, Kingston-on-Thames, Salford, Bradford, Sheffield, Barnet, Coventry, Newhaven, Birmingham, and Dortmund, Germany. In order to arrive at an intelligent view of the case, and to be enabled

to draw conclusions therefrom, it will be necessary to give some of the leading features of a few of them :—

Doncaster, population 26,000. The farm is rented to a farmer at £2 per acre. The farm contains 264 acres. The cost of the works was £50,000. Pumping is required. The expense is £200 in excess of the revenue derived, without including interest or sinking fund on first outlay. Raw sewage applied.

Croydon has a population of 96,000, has two sewage farms, each under the management of a superintendent. The farms contain 525 acres. The sewage is screened but receives no chemical treatment. The cost of the works was £156,000. The annual expense including interest and sinking fund is £7,074 per annum. The sanitary conditions are good.

Bedford has a population of 25,000. The farm contains 223 acres. It is in the hands of a manager who is paid a salary and also receives 1 % commission on sale of produce. The sewage is applied in a raw state ; annual deficit £243 ; no nuisance.

Dewsbury, population 30,000. Intermittent filtration is the method adopted. Effluent very pure ; people bathe in it. The farm contains 70 acres, and in favorable years, not too wet, pays its way, not including interest on first cost.

Merton, population 22,500. Farm contains 28 acres ; intermittent filtration practised ; annual expense over revenue £1,550.

Chiswick, population 21,000, has the separate system. Gardeners take the sludge free ; expense £1,572 per annum ; no returns.

Kingston-on-Thames, population 26,000. The sludge is manufactured into a fertilizer by the Native Guano Company, who receive a bonus of £2,442 per annum. This is the A, B, C process.

Salford, population 176,000. Precipitation works. The sludge is burnt ; annual expense, £3,000. No returns. First cost of works, £20,000, not included in the expense.

Bradford, population 200,000. Precipitation with intermittent filtration ; no pumping required ; sludge given away ; annual expense, £3,300.

Sheffield, population 310,000. Cost of works, £65,000 ; yearly expense, £6,000.

Barnet, population 6,400. Sludge dug into the ground ; cost of works, £10,000 ; annual expense, £627 ; no returns.

Coventry, population 50,000. Sludge pressed and sold; cost of works, £12,000; annual expense over revenue, £2,810.

Birmingham, population 600,000. Farm comprises 1,227 acres. Total cost of the land and works to the present, £403,695. The sewage is treated with lime and the sludge trenched into the ground. The loss on one year's working of the farm amounts to about £10,000, besides the interest on first cost.

I must not close this list without saying something about the disposal of the Edinburgh sewage; so much has been said about the "irrigated-meadows" as they are called.

The information from here is to the effect that "the great volume of Edinburgh sewage is discharged into the sea (Firth of Forth) direct. On each of the three sewer outlets there is a sewage farm, or as before stated, irrigated meadows. These meadows are owned by private individuals who have always claimed a right to the use of the water in the burns passing through their respective lands; which burns have been gradually converted into open sewers."

They have thus fallen heirs to an almost unlimited amount of sewage; they have no interest in purifying this sewage, in the ordinary sense of the word; they use it without stint, and allow the effluent to leave their lands without any regard to its quality or condition. They pay nothing for it, and the crops, chiefly Italian grass, yield good returns

The corporation has not interfered hitherto with the use or misuse of the sewage. The report goes on to say that it is regrettable that one of the farms, viz., Craigentinny, is not the property of the corporation, as it is remarkably well suited for a sewage farm and adjoins the sea; a large part of it consisting of ground reclaimed from the beach, and mostly drift sand.

With the last part of the report I do not feel inclined to agree. If Edinburgh knows when she is well off she will leave that sewage farm alone. While the private owners of these lands no doubt make money out of them, let them once fall into the hands of the civic authorities and they will speedily become a tax on the citizens, or else Scotch aldermen are made of different stuff from the aldermen we read about—in the States.

The only conclusion which can be drawn from the descriptions of the foregoing sewage disposal works is very concisely summed up in a "report of the Society of Arts" appointed to inquire into the various subjects connected with the health of towns, viz.: "It appears further that the sludge, in a manurial point of view, is of low and uncertain commer-

cial value; that the cost of its conversion into valuable manure will preclude the attainment of any adequate return on the outlay and working expenses connected therewith ; and that means must therefore be used for getting rid of it without reference to possible profit. For health's sake, without consideration of commercial profit, sewage and excreta must be got rid of at any cost."

Under these considerations it is no wonder that Mr. Crimp should come to the conclusion that where it is at all practicable a free outfall into the sea can be obtained, it is the most economical and satisfactory method of disposing of sewage. A description of such sewage disposal is afforded by the works at the town of Portsmouth, England. As I wish to draw a comparison between the works of this town and those I have proposed for the City of Toronto, I will give a somewhat minute description.

The population of Portsmouth is 130,000. The district drained is very flat. The highest and most densely populated portion of the borough is elevated about twelve feet only above the tidal range, while about one-third of the borough is very little above the level of ordinary spring tides. I should have said that Portsmouth is situated on Portsmouth Harbor, but it also has another harbor on the east called Langstone Harbor, into which it discharges its sewage. The dry weather flow is about 4,000,000 gallons. The separate system is partly in operation, but in designing the outfall works provision was made for a considerable amount of rainfall per hour.

Owing to the very flat surface of the land, in order that the sewers should be provided with sufficient fall, the sewage has to be pumped. The main pumping station contains a pair of 150 H. P. compound condensing rotary beam engines, each engine works two pumps by means of connecting-rods, one at each end of the beam. The pumps are each capable of delivering half a million gallons of sewage per hour, when doing full duty. Intercepting sewers convey all the sewage to the well at the pumping station, thence by a rising main, 3 feet 6 inches in diameter and 1500 yards long, it is forced by the pump to large tanks situated near the outfall. I need hardly say that one feature of the scheme is the utilization of the tidal water for scouring the outfall pipes.

There are three storage tanks side by side, having a collection capacity of 4,500,000 gallons, and covering an area of 3¼ acres. Each tank is 160 feet long and 150 feet in width. The inverts of the tanks are segmental in cross-section, with a longitudinal fall of 1 in 150 to the outlet. They are provided with sluices at the upper end in order to

admit of part of the contents of a full tank being discharged into an empty one for the purpose of flushing out deposits. Ample provision is made for ventilation, there being 27 fresh air inlets in the three tanks, while the fumes are collected by a flue 4 feet high and 2½ feet wide and conveyed to the under side of a coke furnace, and passed into a chimney shaft about 100 feet high.

The rapid discharge of the whole of the impounded sewage is an essential feature of the scheme; the outlets are sufficiently large to admit of all the sewage being discharged into the outfalls and thence into the sea, within a period of one hour. The mouths of the outlet-pipes lie just below low water mark. Before definitely deciding upon the point of discharge of the sewage, experiments were caused to be made to ascertain the course that would be taken by the sewage under the diverse conditions prevailing. It was found that the floats were carried many miles out to sea when placed in the tide-way soon after high-water, and the works were designed so as to admit of an exceedingly rapid discharge of the sewage in order to take full advantage of this circumstance. On the arrival of the period when it is desirable to allow the sewage to be discharged into the sea, a small penstock is opened, the escaping sewage operates a turbine, which in its turn sets in motion the machinery by means of which the large penstocks are opened; thus one man can readily open these ponderous appliances, and attend to the tanks as well.

The pumping station and rising main cost £25,000, and the tanks and outfall works £45,000. The annual working expenses at both pumping station and tanks amount to £2,700 per annum.

This brings me to my second head.

I have given the sewage disposal works of Portsmouth considerable space as they afford a good example of a free outfall into the sea or large body of water, and I have always strongly recommended that method of sewage disposal for the city of Toronto. Indeed, it was a consideration of the immense advantage to sewage discharge afforded by tidal waters which led me to devise a scheme that would secure to Toronto the advantage of a tide, though on the tideless waters of Lake Ontario, and those of you who are familiar with my scheme will recognize how fully these have been secured. You will observe that by means of a high-level sewer along, say, Gerrard street, between Yonge and Parliament streets, intercepting all the sewage north of that line and conveying it into a tank situated down near Front street, we secure the benefit of a tide, not ten or twelve feet high, but 32 feet high, or more if we require it. Next, we can have it just when we want it and have

not to wait upon the "tardy favors of the moon." By adjusting the size of our tank, and extending our high-level sewer to the west and thus intercepting more sewage, we can determine the time of filling the tank as we choose, to one hour or less or more. Thus by intercepting 4,000,000 gallons per day, and making the tank to hold half a million gallons, we would have a discharge every three hours, equal to eight tides in the day; even Jupiter with its four moons could not do much better than that. But if we chose, we could have a discharge every hour or every half hour.

Then another feature, considerably emphasized, is a rapid discharge; having 32 feet of head, our discharge would be nearly double as rapid as theirs.

Not having to provide storage for the whole city for 12 hours, say six million gallons, we only need to provide capacity for half a million. By a simple contrivance of automatic flushing apparatus we save the attendance of even a single man. Then last, but not least, we save all the expense and nuisance of pumping. It may be egotism, gentlemen, but I consider I have made a tolerably good substitute for the tides.

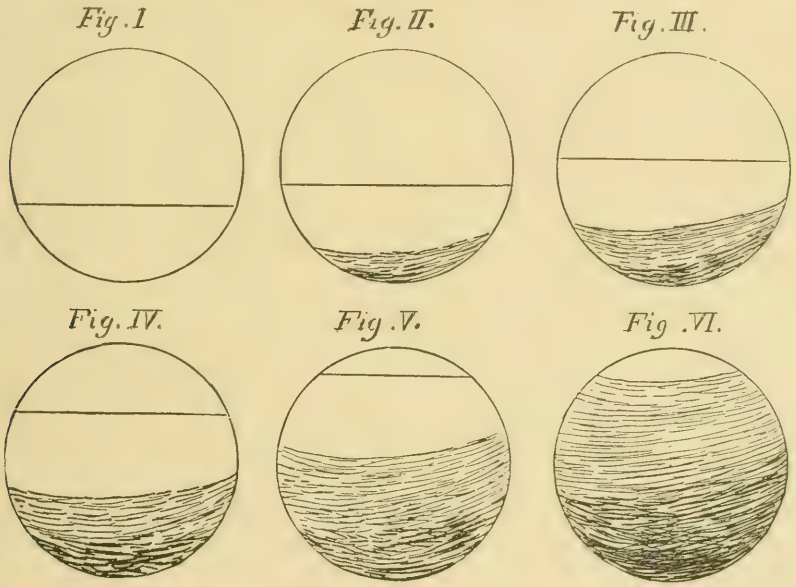
But there is one further merit which I claim for my system that I have not yet laid before the public. You are aware that I contemplate an outfall pipe of steel 6 feet in diameter, conveying the sewage out to a depth of 33 feet of water. I recommend several openings along the pipe near the outlet to be used alternately. This would give a better distribution and prevent accumulations of solids. Again, as the sewage would be discharged at intervals with great force, it would prevent a deposit of the solids around the mouth of the outlet. And even between the intervals of flushing, while the sewage of the low-level sewer would be passing slowly out of the outlet-pipe there would be no deposit around the mouth. As at such time the motion would be so slow as to allow a deposit to take place in the pipe, only the comparatively clear effluent would flow out, leaving the solids along the bottom of the pipe until the next rush would take place, when half a million gallons sweeping along at the rate of 6 feet per second would again scour the pipe and carry the solids far beyond the end of the outfall.

Mr. Crimp recommends the adoption of the gravity schemes where possible, notwithstanding the greater initial expense. He also is in favor of provision being made for flushing all sewers of insufficient fall.

He also describes a very ingenious precipitating tank in use at Dortmund, Germany, and also Mr. Webster's treatment of sewage by means

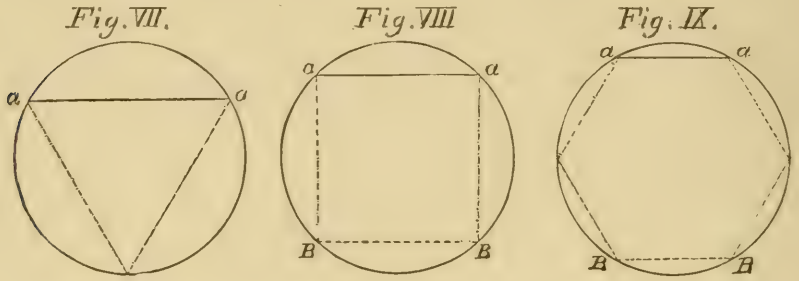
of electricity, styled electrolysis, which is also fully described, but time precludes me from giving a description of them in the present paper.

III. Under the third head I wish to point out some general defects in the sewerage and sewage disposal works of towns and cities. The first defect relates to the size and fall required by sewers. These should be considered with a view to the amount of sewage required to be carried by them. They should be regulated to such a size that they will run from ½ to ⅔ or ¾ full. Let me illustrate what takes place when a sewer is too large. We will suppose a sewer is constructed 4 feet in diameter, and that the depth of sewage flowing in it is one foot,—much less than this is very common. I was informed that on Perth street a sewer 4 feet in diameter was being constructed, and I am satisfied that the depth of sewage flowing in it will not average one foot.



Owing to the small volume of sewage coming in contact with the comparatively large surface of sewer pipe as in Fig. I., the friction will be comparatively greater, and though the fall might be sufficient to produce a scouring action were the sewer running full or half full, the motion will be retarded till deposits begin to take place as in Fig. II. This, you will observe, increases the frictional surface and still more retards the flow; when sedimentation will go on more rapidly as in Fig III., IV. and V. Here you might suppose that the evil would begin to cure itself, as the restriction of the passage, as in Fig. VI., would cause an increased velocity, but not so; increased velocity cannot be obtained

without increased head and when you consider that the system of sewers forms a net work you will see that this head cannot be obtained, as the sewage will make its escape through other connections, and the sedimentation goes on till the pipe is completely choked. This may be seen again and again in Queen street sewer and other sewers throughout the city.



A formula for calculating the coefficient of friction in pipes running partly full is as follows :—Coef. of F $= \frac{\text{F. Sur.}}{\text{V. of Sew.}}$; regarding the coef. as unity when the pipe is running full or half full, as you will thus see, the whole F. Sur. ÷ whole vol. = 1. or ½ F. Sur. ÷ ½ vol = 1.

Fig. VII. shows the circle divided into two segments by the side of an inscribed equilateral triangle, figures VIII. and IX. are similarly divided by the side of an inscribed square and hexagon respectively. In Fig. VII., consider the sewer filled to the line *a. a.*, the frictional surface would be represented by ⅔, while the Vol. of Sew. = ⅘. Then by applying the formula $\frac{2 \cdot 3}{4 \cdot 5} = \cdot 833$, = Coef. of F. While the small Seg. would give $\frac{1 \cdot 3}{1 \cdot 5} = 1 \cdot 6$ = Coef. of F. The latter being double of the former.

Similarly, if Fig. VIII. were filled to the line *a. a.*, the F. Sur. would be ¾, while the Vol. of Sew. would be $\frac{10}{11}$; then by applying the formula we get $\frac{3 \cdot 4}{10 \cdot 11} = \cdot 825$, = Coef. F. While the smaller Seg. shown by *b. b.* would be $\frac{1 \cdot 4}{1 \cdot 11} = 2 \cdot 75$ = Coef. of F. The latter more than three times the former.

Fig. IX. gives a more marked contrast still. In the large Seg. cut off by *a. a.* the F. Sur. is represented by $\frac{5}{6}$ while the Vol. of Sew. is $\frac{17}{18}$, then $\frac{5 \cdot 6}{17 \cdot 18} = \cdot 882$, = Coef. of F. While the small Seg. cut off by *b. b.* would give a result of $\frac{1 \cdot 6}{1 \cdot 18} = 3.00$. Coef of F., nearly four times as great as in the larger segment. You will observe that figures VII. VIII. and IX. give Coef. respectively, of ·833, ·825 and ·882, thus Fig. VIII. having the lowest Coef. would give the best maximum of velocity. And thus we obtain the paradoxical result that a pipe flowing partly full will have a better Coef. of discharge than when flowing full.

By applying this formula to Mr. Jennings's Outfall Sewer, which is designed to have a diameter of 8 feet, with a fall of 1 inch in 1500, the conditions would be as described in Fig. VIII., small segment. Allowing from 8 to 12 million gallons daily flow, sedimentation would take place very rapidly.

I did intend going into a minute criticism of the present scheme before the city, but as you are, no doubt, pretty well loaded up with the subject, and as there appears no immediate prospect of putting it or any other scheme into operation for some time to come, I shall, with your permission, reserve it for a future time.

LAKE CURRENTS.

BY L. J. CLARK.

(Read 7th March, 1891.)

With the opinion that there are any regular, constant, well-defined lake currents, I feel inclined to disagree. The theory that the waters of the Niagara River make direct across the lake and strike the north shore about the neighborhood of Scarborough Heights, and are then deflected to the east or west, forming currents, is, I think, a highly delusive one; or, as Mr. Sandford Fleming characterizes it, "a theory wild and incapable of defence, though some there are bold enough to venture it." Crossing the lake one day last summer, when nearing the mouth of the Niagara river, I asked the captain how far out he felt the influences of the current? He replied, "about two or three miles." I asked him what velocity he supposed it had? He said from three to four miles per hour, and that when a strong east wind was blowing it would be turned to the west, and *vice versa;* and that it deposited its detritus a short distance from shore; thus showing that its current is practically checked when it strikes the great body of water in the lake.

I believe that the uniform tendency of the water is towards its outlet at the east end of the lake, and that the only other currents that exist owe their origin to such causes as stated by the captain above referred to, namely, the winds. That there are currents produced by this agency no one will, I think, deny. But it is to the currents in our immediate neighborhood, and along our own water front that I shall call your attention to-night.

The question becomes of primary importance when considered in connection with any method of sewage disposal, which looks to diverting the sewage, crude or partially purified, into the lake. An investigation, then, of the Lake currents bears the same relation to sewage disposal that *testing the waters of Lake Simcoe does to the gravitation scheme,* or the newer method of supply by artesian wells; first find the *flowing region.*

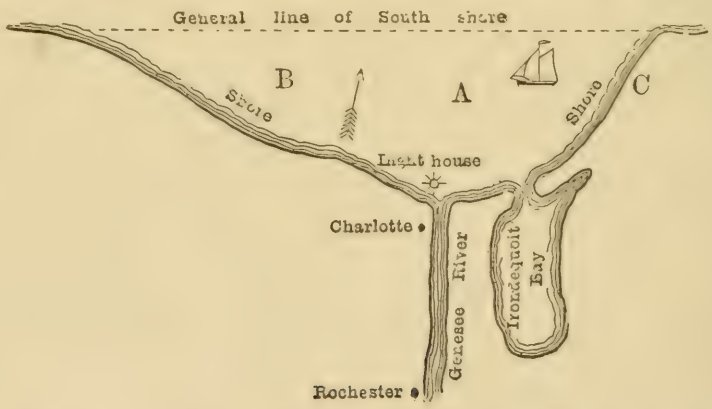
A somewhat remarkable statement was made by a prominent sanitarian, within the last twelve months, to the effect that the proposal to discharge the crude sewage into the lake would be fraught with the greatest danger to our water supply, as it was proved that any impurity

thrown into the lake as far as seven miles east of the intake pipe would, under the influence of strong east winds, reach the pipe in three hours. If this statement could be proved it would settle the matter in short order. It led me to follow up the question a little further and I reasoned thus; if the winds drove the water along at the rate of 2⅓ miles per hour it would reach Hamilton in about 16 hours. It is quite evident that the surface of the water is more influenced by the wind than at greater depths. We will suppose that 10 feet of the surface is so influenced, and that a storm lasts, as most easterly storms do, from two to three days; then consider that the cross section of the lake is somewhere about 40 miles broad, and that 10 feet of the surface is focussed on Hamilton for three days; the unhappy fate of that city may easily be predicted. She would no longer offer a butt for the stale jokes of Toronto wits, but we should speak of her in all sisterly tenderness as the "dear departed." The mountain would no doubt come in handy to the natives of the Ambitious City.

But, in all seriousness, it must be conceded that the influence of the winds and waves has a tendency to move the surface more or less in their own direction, and that during a strong easterly gale a few feet of the surface of the water is driven in a corresponding direction; and this is verified by the fact that under such conditions we find the level of the lake raised a few feet along the Hamilton beach. But though the storm may continue for days with unabated force it does not rise any higher; so what is the only conclusion we can arrive at? Only this, that the head so raised forces a portion of the water back as an undertow, and forms a current in the opposite direction. Thus it is evident that were a sewage outlet located well to the east of the intake of water, say in the neighborhood of Scarborough Heights, very little danger, if any, need be anticipated; for when an easterly storm arises it will give rise to an undercurrent in an opposite direction, which will first flow past the intake of water, thence on to the sewage outlet and so on to the east. So that any charge of water contamination from such a cause is as baseless as the wolf's indictment of the lamb for disturbing the water he was drinking. The answer which the lamb made will suffice for us, "Pray how can that be since the water flows from you to me." If this theory be true it will seriously militate against a westerly discharge of sewage as advocated by some local sanitarians, or against the two or three minor outlets to the west as recommended in the latest report on the subject. It stands to reason that it is unwise to have outlets both to the east and west of the intake of water, for whatever the conditions or nature of the currents that will render the one secure will cause the other to be a certain danger.

Reverting to my theory of an undertow current in an opposite direction, I may say that it rests on something better than "empty air." I was fortunate enough to meet with a gentleman who assisted in making some observations of lake currents in 1884 and 1885, and he informed me that the floats of a few feet in depth invariably travelled in the direction of the wind, but that the floats over twenty feet in depth always travelled in the teeth of an easterly storm, but he had not observed it to do so in the case of a westerly storm. I should have stated at an earlier period that, in my opinion a wind from the west does not produce an undercurrent in an opposite direction, for the very obvious reason that the outlet of the lake is to the east, and when the water is blown down the lake it makes its exit by the St. Lawrence instead of returning as an undertow.

But I have better evidence still than the above. Some two months ago I explained this theory in a newspaper article, and in response to it I received the following from an eminent American engineer. And I trust he will not consider it a breach of confidence if I give it in his own words: "I was greatly interested in reading your article in the *Globe* on 'Lake Currents,' and perhaps you will be interested in the following facts which were communicated to me by the captain of a life saving crew at Charlotte. The shape of the lake shore is as sketched. A



yacht capsizes at A during a severe westerly gale, the ballast shifts to the bow, leaving the stern rising out of the water so as to form a float. Despite the heavy wind and surface currents tending to drive the yacht to C, it was observed to travel slowly westerly in the teeth of the wind and found a few hours later at (B)! As you describe it, the water was piled up along the shore at C, and by the head so formed a portion ran backward as an undertow towards B, thus making a temporary whirlpool. This is due to the peculiar shore conformation, and the sewage problem

must be studied with reference to such matters. In your shore a similar indentation is formed by Humber Bay, and you are right in advocating a sewage outlet to the east, where the coast line is straight for a considerable distance."

But, however satisfying this theory may be to the scientist, it should be put to the severest test before the least reliance is placed in it. And I hope the city authorities will not allow the present season to go by without ascertaining to the fullest possible extent the direction and velocity of the lake currents, both deep and superficial, under all existing circumstances.

The result of the recent analysis of water from the bell buoy by Professor Ellis, might be considered a staggering blow to the credulity of those who had faith in the purity of the water from that source when not contaminated with impurities from the bay through leakage into the conduit, but not necessarily so. The rather does it show the danger from western sewage outlets, and from the polluted waters of the bay. It was very ably shown by, I think, a writer in the *Mail,* that the wind rising in a certain quarter, and veering around to a different quarter, would tend to bring the foul waters of the bay directly to the intake pipe. This mechanical cause may have been aided by a physical cause, namely, the difference in temperature and consequently a difference in density. Thus at the time the sample was taken the weather was tolerably cold, the ice had just left the bay. The water in the shallow portions inside the harbor is much more susceptible to changes of temperature than in the deep water just outside the island. Suppose the temperature of the water in the bay to be 39° Fah., its limit of greatest density, and that outside to be 40°. Then as the water would be driven out of the western gap as before described and around Lighthouse Point, it would encounter the lighter waters of the lake and sink beneath them, carrying down its load of sewage pollution to the bottom to contaminate the water at the intake. But this state of things is not irremediable. Cleanse the harbor, cut off the westerly sewage outlets, and extend the intake pipe out to 70 feet of water and all danger will vanish ; for it must be remembered that conditions may arise that would contaminate the surface water at the location of the intake pipe which would be perfectly harmless at a depth of 70 feet below.

SOME EFFECTS OF CHRISTIANITY ON LEGISLATION.

By The Hon. W. Proudfoot.

[*Read 7th February, 1891.*]

I shall not attempt to enumerate all the instances in which the distinctive principles of Christianity have influenced legislators in enacting laws for the government of nations and peoples ;—it would be far beyond my power or my knowledge to do so ;—and it would perhaps be above the capacity of any one, as the gradual prevalence of these principles may have enlightened the minds and softened the manners of statesmen, in a way that would not be open to observation, and in many instances not acknowledged or felt even by themselves.

For the same reason it would be difficult to select instances in modern times on which you could place your hand and say, *this is an outcome of Christian principle*, without being met by the objection that it was as probably due to the general advance of civilization, to the progress of the human mind, to reasons of state or expediency—perhaps to the exigencies of party strife.

I shall therefore ask you to turn back your glance to those earlier times, when Christianity, after more than three centuries of oppression, neglect and persecution, during which its teachings and the pure lives and devotion of its worshippers had spread their beneficent effects in an ever widening range, at length numbered the rulers of the world among the disciples of the cross. It was then placed in a situation whence its principles could be employed with legal effect to ameliorate the condition of the race, to repeal cruel and bloody laws, to abolish sanguinary customs, and lend its gentle and persuasive power to induce men to become more compassionate, more tender, more humane, to the poor, the helpless, and the suffering.

That it did not effect all this at once, that it has not fully effected it yet, is no reproach to Christianity. It has to work with feeble and fallible instruments, it has to contend with passions, with the iron chain of habit and custom, superstition and prejudice ; it has never claimed to free men entirely from the liability to act wrongly and wickedly, it does not make man perfect, to do that it must take him out of the world. But if it has succeeded in staying the hand of the oppressor here and there, in binding up the wounds of the oppressed, in wiping away the

tears of the sorrowing, and in producing compassion for the helpless and suffering, has it not been carrying into practice the precepts of its founder, and elevating humanity itself by teaching the common brotherhood of man ?

The particular laws which I ask you to consider, are those having for their objects; The preservation and protection of infants; The support of the poor; The establishment of hospitals for the sick and the incurable; The encouragement of the emancipation of slaves; The prohibition of gladiatorial contests; And the mitigation of punishments.

To this audience I need scarcely say that all these are duties inculcated by our religion. We are told that children are a heritage of the Lord. The want of them was deemed the greatest privation. Give me children or else I die, said the Hebrew wife. They were esteemed the most precious blessings. The grand old prophet, while he thought it possible for a mother to forget her sucking child, yet places it next to that impossible thing that God should forget his people. And we can have no higher idea of the value, the sanctity of children, and the tenderness with which they should be treated, than was given by our Lord himself, when he would not suffer them to be removed, but took them in his arms and blessed them, for of such is the kingdom of heaven.

The poor shall never cease out of the land, therefore, thou shalt open thy hand wide unto thy brother, to the poor, and to the needy in thy land. We are also directed to judge righteously, to plead the cause of the poor and needy. One of the transgressions for which punishment would not be turned away, was selling the poor for a pair of shoes.

The general duty of compassion to the poor and suffering is exemplified in the account of the last judgment when the Lord shall say unto the wicked, "I was an hungered and ye gave me no meat; I was thirsty and ye gave me no drink; I was a stranger and ye took me not in; naked and ye clothed me not; sick and in prison and ye visited me not. And inasmuch as ye did it not to one of the least of these my brethren ye did it not to me."

Let us now see with what these principles had to contend.

The Romans had long been renowned for their supremacy in the arts of peace as well as of war—and they attained such a high degree of intellectual civilization as has perhaps never been surpassed. They did not excel the Greeks in the politer arts, music, sculpture, painting and poetry; indeed they affected to treat them with some disdain, claiming that *their* mission was to give laws to subject nations. In this respect their pre-eminence was just; no system of laws has ever been devised

superior to the Roman Law, which, after the lapse of many ages still continues to guide legislators and jurists of nations that have arisen and flourished since the Roman power has passed away.

One of the institutions that Justinian considered peculiar to the Romans, though in this he appears to have been mistaken, as the Galatians seem also to have possessed it, was the *Patria Potestas*, the exclusive, absolute, and perpetual dominion of the father over his children by a lawful marriage. It is said to have had its origin in the barbarous customs of the earliest Romans, and from them to have passed into their laws, and to have been sanctioned by the laws of their kings long anterior to the XII tables. And this Royal law of the Paternal authority was transferred by the Decemvirs into the 4th of the XII tables, as Dionysius relates, who sums up the particulars of this authority as permitting fathers to beat their children with whips, to confine them in prison, to make them work in chains in the fields, to sell them, and in fine to kill them. The Romans were not allowed to disown or deny their children, but only to order them out of their presence, and thus dismissed from home they did not lose their right to their father's property, unless they were disinherited. Armed with these rights the paternal authority was deservedly deemed peculiar to the Romans, and a part of the civil law, since elsewhere it had never attained such a height. The father was appointed as it were a family magistrate with the power of the sword. Only Roman citizens could exercise it; and if the citizenship were lost so was this authority, as in the case of those to whom fire and water were interdicted. Livy terms it *Patria Majestas*. For the father could treat his sons as he did his slaves; who in this respect were better off than sons that by one sale and manumission they attained their liberty, while sons were only liberated by a third manumission. Sons had this advantage however that while by manumission slaves only acquired the condition of *freedmen* (still owing certain duties to their former master and patron) sons reached the condition of their original free birth; which was so highly esteemed that it was not lost by the sale, but rather covered; and when manumitted this innate condition was recovered as if by bursting its bonds. Hence it was said that fathers could not take liberty from their sons. And by fictitious sales and manumissions a mode of liberating the son from the operation of the paternal authority was devised, and thus acquiring irrevocable liberty. A father could not sell his son if he married with his father's consent. The Romans began to modify the atrocity of the paternal power after acquaintance with humaner studies, and intercourse with more polished nations had rubbed off the original rust of their manners. In later times the supreme authority was rarely

exercised. But in Cicero's time it was in full force, for Fulvius the son of a senator was slain by his father's command for conspiring against his country with the followers of Catiline. At a later period Erixo whipped his son to death. And Hadrian banished a parent for killing his son.

Pothier, the well known French jurist, finds nothing averse to natural affection or good morals in the immense power thus vested in fathers, for he maintains that no capricious authority was conferred, but that the supreme magistrate in the family proceeded against the guilty in a domestic tribunal, which in the early stages of society was the only mode of exercising legitimate authority; and after governments were formed and laws enacted, why should not that *imperium* be preserved to fathers which in other nations was committed to newly created magistrates; especially when it must be presumed that paternal affection would moderate it to the rule of equity and justice? Besides, the law did not command fathers to exercise this right, it only permitted it, and it asks no reason for enforcing it, as it does not assume that it would be otherwise than just, and that nothing would be decreed by a father against his son at the mere pleasure of his will. But it was rather to be apprehended that natural affection would generally spare the guilty; and therefore, besides the private jurisdiction preserved to the father, sons might also be subjected to the authority of the magistrates. That he had nowhere read of fathers having abused this power before the integrity of Roman manners was weakened and broken, nor of any complaint being made of the right of the sword, or of sale. Though a sale was freely permitted, the legislators safely trusted that it would be exercised only in two cases: 1st, as the penalty of some serious crime committed by the son, which the father should determine to be punished by sending him into slavery, in which case why might not he sell, who could inflict death? 2nd, by reason of extreme poverty, when the father had no other means than the sorrowful price of his son for procuring the necessaries of life for himself and his family. It was better that the son should be sold than die of hunger, nor should he prefer his liberty to his own or his relatives' preservation. He admits however, that in the course of time, when the state had become infected with the corruption of conquered nations, parents abused their power.

Historians tell us that the practice of killing, exposing, selling and pledging infants on account of the poverty of their parents has always been prevalent, but in the early part of the fourth century had become excessively frequent in Italy. That part of the empire was exhausted by the imposition of great taxes, by the frequent changes of sovereigns,

and finally devastated by the tyranny of Maxentius. Parents were impelled by poverty to sell their infants or to destroy them.

Constantine the Great was the first Christian emperor. He was proclaimed at York, A.D. 306. He defeated Maxentius at the Milvian Bridge, and thus acquired the control of Italy in 312, and his conversion dates from this time. The edict of Milan, granting toleration to the Christians was issued in 313. His character has been the subject of much difference of opinion. By one class of writers he has been represented as a sanguinary hypocrite, stained with the worst crimes, and only at the point of death becoming a member of the church by baptism, so as to make the best of both worlds. Others speak of him in terms of adulation. In truth he had a difficult part to play. The greater number of his subjects must have been Pagans. To have forced his own belief on them might have led to rebellion. It was the part of a wise statesman to hasten slowly, and not by undue precipitance to embitter the majority of his subjects, but to modify by degrees the defects in their manners and customs. He was also probably not entirely free himself from the prejudices of early education. But the best evidence of his character is to be found in his laws, and these form a lasting monument to his fame.

Three years after defeating Maxentius he enacted a law, and amended it seven years later, (315-322), with the view of deterring parents from destroying their offspring. It authorized poor parents, suffering for want of food and clothing and unable through poverty to rear their children, to procure food and clothing and necessaries from the public funds and from the private fortune of the Emperor without distinction. Enabled thus to escape the sufferings of extreme poverty, they might gratify parental affection by keeping their children at home without the hazard of seeing them die of hunger. This law as well as several others promulgated the same year, are usually supposed to have been suggested by Lactantius, a christian of great eminence for his learning and eloquence, and then the tutor of Crispus the son of the Emperor.

A custom prevailed extensively in Constantine's time of exposing, killing, selling, and pledging *new born* infants, and with the view of protecting them, if their father chose to exercise his paternal power, and not to seek the assistance he might obtain for the support of his children under the provisions of the constitution of 315, Constantine in 318 enacted that he who killed a parent or a son should be guilty of parricide. This put an end to any legal exercise of the most odious part of the paternal authority. A parent could no longer claim the right to avenge his wounded affections or honor by the infliction of the last punishment on an offending son or relative under his power. And a

father violating this law was subjected to the grotesque punishment of being enclosed in a sack with a serpent (a dog, a cock, and an ape, were added by Tribonian) and cast into the sea. Another constitution was issued in 329 which at first view seems rather inconsistent with this thesis, since it provided that any one who should purchase a new born child and rear it should have the full power of holding and possessing him. And if the owner or father desired to recover it he was obliged to give a slave in his stead, or pay the price at which the preserver should value the child. You will recollect that by a sale under the *patria potestas* the liberty of the free Roman was not extinguished—only veiled —and the parents or the person sold might assert his liberty without recompensing the purchaser. In the troubled condition of the Empire, the people harassed with the exactions of contending claimants for supremacy, the country devastated by opposing armies, when every highway and by-way resounded with the clash of arms or the tread of marching troops, few even of the benevolent would care to purchase or collect sold or exposed infants which might be reclaimed at any time without reimbursing the expense of maintenance. It was therefore a wise and benevolent provision for the security of the helpless, and would induce persons to purchase those that would otherwise perish, to give the right of ownership to the purchaser. The child bought under this law became truly a slave, but subject to the contingency of redemption on payment of his value, or by the substitution of another slave in his place.

A further advance was made two years later, (331) toward securing children from exposure. A constitution was issued in that year giving to any one who should pick up a boy or a girl cast out of home with consent and knowledge of the father or master and should feed and restore him or her to vigour, the right to retain him or her either as a son or daughter or as a slave, without any apprehension of being recovered. This evidenced great progress on the side of humanity, as it made no distinction whether the abandonment was caused by want or pressed by no necessity. All that was required was that the father or master should know, or wish, or require the act to be done. And he no longer had the right, preserved to him under the former law, of recovering the child on paying for its maintenace. This provision was neither cruel nor unjust. Constantine thought that the wicked practice of exposing children was subjecting them to death, and he wished to deter masters and fathers from doing it. To poor parents he had already (315) provided means of sustenance. He desired further to deter fathers and masters by the dread of losing the right of asserting the freedom of

their sons, and to deprive them of the right of property and of the *patria potestas*. It was another blow struck at the peculiar institution.

Another constitution, showing the gradual progress of more gentle manners and of greater consideration for the young, was made by the Emperors Valentinian and Valens in 365, which permitted parents to correct their children in moderation. If the correction did not effect its object recourse was to be had to the judges. And in 374 the killing of an infant by any one was declared to be a capital crime. This law did not declare the crime, for before this the killing of an infant was a homicide, but the punishment was only banishment ; it was now increased to death.

In 391 Valentinian, Theodosius, and Arcadius enacted that all who had been sold into slavery to procure food for their wretched parents should be restored to their former free condition without recompensing the price. This in effect repealed the law of Constantine requiring the price to be repaid or a substitute given. Both laws were in favour of liberty, but the mode of effecting it varied. Both opinions may be supported by probable arguments. If you take away the hope of recompense for expenses, few in desperate circumstances will stretch out a helping hand. On the other hand if payment be insisted on you may take away the hope of acquiring liberty ; and impelled by a momentary necessity that inestimable right is parted with for money. The most equitable rule would be that no christian (or other person) should be sold under any necessity. though they might be sent to service not to slavery.

In 451 Valentinian III. seems again to have found it necessary to modify the law, as he gave to the preserver of free born sons sold from necessity, the right to receive the price paid with 20 per cent added.

Finally Justinian in 530 reverted to the law of Constantine of 429.

We have thus seen with what anxious solicitude the christian Emperors for a period of 200 years had endeavoured to soften, to modify, and vary the harshness and cruelty of laws and customs originating with the earliest traces of the history of the Roman people, and adhered to by them with a passionate attachment that was not overcome by the proffer of aid from the public treasury, and only at last gave way to the prevalence of christian sentiment and christian principles.

THE POOR AND THE SICK.

In the early period of the Roman history, (1-300) I do not find that any provision was made for the relief of the poor. Inequalities which spring from family and fortune must necessarily exist in every society ; and

doubtless benevolent persons were found who compassionated the distress of poverty and aided to relieve it. But there was no acknowledgment of any *right* of the poor to relief, nor any sense of *duty* among the prosperous to contribute to their support. Laws were indeed passed against usury, and from time to time others were proposed for the division of the public lands; but yet the poor had no asylum in which they could seek shelter; there existed no law that concerned them, unless it were that which fixed the amount of funeral expenses, introduced in their favour as a means of preventing the ruin of families.

At a later period, (300-650) the more considerable independence acquired by the Plebeians, but especially the progress of the republic in wealth and power, resulted in numerous projects tending to procure for all the Romans, without distinction, the many conquests they had made. In this category may be ranged, 1st, the Agrarian laws, relative to the division among the poor citizens of the lands, the ownership of which no one denied belonged to the whole people, or at least had at first belonged to it; 2nd, laws as to the pay and other privileges of the soldiers; 3rd, laws for the distribution of grain; 4th, the abolition of the custom that obliged private persons to maintain the roads at their own expense; and 5th, the abolition of all imposts which were previously apportioned according to the census. During this period the poor, in consequence of the number of enfranchisements, increased daily and formed the major part of the Plebeians. Many tribunes of the people hastened to profit by this, and spared no means of conciliating the multitude. They succeeded best by modifying, at least momentarily, the excessive rigour of the relations between a creditor and his debtors. The severity of the execution on the person of the debtor was abrogated. It was prohibited to put debtors in chains, but the creditor might take him home and exact service from him. Wealthy men, ambitious of power, cultivated the people with as much assiduity as a modern candidate for parliament—furnished food and amusements, maintained large numbers of retainers, and protected them in violating the laws. Successful tribunes obtained and perpetuated their popularity by securing the enactment of laws for extinguishing debts, either wholly or in part, or enlarging the time for payment. A large part of the public expenditure consisted in the distribution of grain to certain classes, which completely destroyed agriculture in Italy, for the grain was bought at a low price and imported for the purpose.

In writing this I overlooked the benevolence of Trajan and some wealthy men of his time. Trajan provided for the maintenance of nearly 5000 children of free parents in the different cities of Italy. Pliny Panegry, 26, 28. Arnold, History of Later Rom. Com., 2, 414. Pliny

settled an annual income of 300,000 sestertii for the maintenance of free born children in the town of Comum, his native town. Pliny Ep., vii, 18, Arnold, u. s., and 471, the annuity was a perpetuity. That of Trajan appears to have been only during his reign ; that the youth might be a resource in war, an ornament in peace, and that they might learn to love their country not only as a country, but as a nourishing mother. Plin. Pan., c. 28.

But all these except the last, were modes of winning the favour of the multitude, for the ulterior designs of the demagogues who employed them, not out of tenderness for distress, or of compassion for penury and want. And when the republic was transformed into an empire, the senate lost its power, and the ambition of private persons was directed towards obtaining the favour of the monarch, the emperors were obliged for some time to continue the distribution of provisions and gratuities to keep the needy from becoming disturbers of the state.

There was equal want of care for the sick, the helpless, the incurable. There were no hospitals for their reception, no provision for giving them medical attendance, or for maintaining them. The nearest approach I can find to any care and consideration for such unfortunates, is an edict of Claudius, by which he enacted, that when sick and diseased slaves were exposed in the temple of Aesculapius, on account of the trouble of curing them, all who were exposed should be free, nor return to the power of their masters if they recovered.

In considering the change in this respect after Christianity became dominant, it is impossible to separate it from the donations, privileges and immunities granted to the church and to the clergy, as whatever was given to them was deemed not an acquisition for their personal advantage, nor to increase their pomp and power, however much they may have been diverted from their purpose at later periods when corruptions crept into the church, but they were assigned to them in trust for the religious and benevolent purposes imposed upon them by the religion they professed.

With this view edicts were published encouraging bequests to the church,—the property of the church was declared inalienable,—many privileges were conferred on the clergy and on church property, exemption from most of the burdens of the state, and from answering in secular tribunals for any but criminal offences. In the one hundred years after Constantine's declaration of toleration, no less than forty-seven edicts may be seen in the Theodosian code, granting, extending, modifying and confirming the privileges and exemptions of the church and its property.

Thus in 321 Constantine conferred upon any one the fullest power to bequeath property to the church, a privilege not previously possessed,—and it seems to have been construed as extending to every kind of property real as well as personal. A short time (326) afterwards he issued another edict restraining the wealthy from seeking admission to the ranks of the clergy, a profession that had become exceedingly advantageous from the immunity from public duties they enjoyed under a previous law (320) and he assigns as a reason for it "that the wealthy should bear the burdens of the State, and the poor be sustained by the wealth of the clergy."

Valentinian in 454, after reciting that he had a humane desire to provide for the indigent and to endeavour to secure maintenance for them, directs that the provision of various kinds which had been made to the churches till that time at the public expense should be continued, forbade any one to diminish it, and confirmed the liberality for the future. And in the following year (455) he authorized widows, deaconesses, and converted virgins to bequeath their property to the church, to a temple dedicated to a martyr, to an ecclesiastic, to a monk, or *to the poor*. At a later period however Justinian considered this inoperative as to persons who had been consecrated in a monastery, as by the consecration their property belonged to the monastery and therefore they could not bequeath it.

The Emperor Leo in 470 by a most elaborate constitution prohibited the alienation of the property of the church whether moveable or immoveable, even though the bishop, all the clergy, and the steward (trustee) of the property should consent to it; for it was as necessary to preserve the property of the church as the church itself; as the mother of religion, and of faith is perpetual, so should her patrimony be preserved in perpetuity,—and by a sweeping clause he declared that the money produced by the sale should belong to the church, and the property itself be recovered, with all its fruits and accretions in the intermediate period,—the steward was to be dismissed and he and his heirs bound to compensate the church for any damages,—the notaries who drew the instruments were to be condemned to perpetual exile,—and the judges who approved of the sale were to lose their offices and forfeit all their property. Justinian extended this to the property of all pious institutions. It was to be observed in perpetuity as to all property derived from the Emperors. The other property of the foundations might be sold to pay pressing debts, first applying the moveables, and then, with many precautions, the immoveables. The monastery itself could not be sold. The steward and his relatives could in no way

acquire any of the property. Ruinous buildings might be let on perpetual lease at not less than ⅓ of the usual rent. Property received from the Emperor might be exchanged with him for other of equal or better value, or exchanged with other churches.

Justinian (528) by a constitution reciting that the ancient laws had declared, though obscurely, that donations made for pious uses were valid without registry, ordered that donations of any kind of property to the value of 500 solidi (about 500 guineas) or under, made to a church, to an hospital for relief of strangers, or for the care of the sick, or for orphans, for poor houses, for houses for poor old people, for foundlings, to the poor themselves, or to a town, should be valid without registry. He prohibited by another law the sale of sacred vessels, unless they were useless, when they might be sold for the payment of debts. And by another grants to any of these pious uses by any of his courtiers should be valid in their entirety, *i. e.*, without deducting the ¼ that in such cases went to the Emperor. Further to enlarge the privileges of these pious houses he relieved them from the ordinary rules as to limitation and permitted them to assert claims to lagacies or trusts at any time within 100 years.

A reason given by Constantius (357) for exemptions he was granting to the clergy, was to enable them to employ their revenues in the support of the poor. And Valentinian enacted that a legacy given to the poor should be valid, and not objectionable on the ground that it was given to uncertain persons, but at all events should be confirmed. The emperor Leo made a similar provision as to legacies for the redemption of captives. If the testator appointed a person to employ it, he should do so, if none, then the bishop should. Justinian codified the dispositions to the poor, and for redemption of captives—making the dispositions valid though in general terms for these objects, and directed by whom they should be administered.

I have been thus minute in collecting some of the laws during a period of two hundred years from Constantine, to show how much the Christian element entered into legislation, and that these various provisions were not made for the benefit of the clergy, but through them for carrying out the principles of the church in its relation to secular affairs—for the relief of the poor—the sick—the helpless.

I now ask your attention for a short time to consider how much these laws may be deemed to have had their origin in the teachings of the church.

From the earliest period the Christian teachers maintained the sacred and inalienable character of the property and revenues of the church.

Anaclete a bishop of Rome, in the last quarter of the first century says: "He who shall steal anything from his father or mother, and shall say it is not a sin, is guilty of homicide. Our father without doubt is God who created us; and our mother is the church which has regenerated us in baptism, therefore, he who steals the money of the church and of Christ is a homicide." Stephen, who flourished 253, repeats slightly modifying the phrase, so that the robber is to be looked upon in the same light as a homicide in the eyes of the judge. Eusebius (264-340) the historian says, that bishops cannot transfer any of the revenues of a monastery into the hands of a prince or any other person, that by the apostolical canons he has the care of the ecclesiastical property to dispense it as in the sight of God. He is not to give any of it to his relatives, *unless they be poor, and then only to distribute among them as to the poor, but not so as to defraud the church.* And at the same time Eusebius the bishop (310) declared that he who committed sacrilege should do penance and restore fourfold.

Till this time the penances and penalties for alienation of church property and sacrilege were purely ecclesiastical. The Christians had no legal position in the state; they only emerged from a position of contempt to one of persecution. But after the edict of toleration, (312) their censures were recognized by the state, and their authority to punish was sanctioned by the secular power. From this time onwards the prohibition to alienate was repeated by the authorities of the church, as well as by the edicts of the emperors,—a full and ample declaration of the law was made by Justinian, and subsequent to his time the same was often declared, the prohibitions were renewed, and the sacredness of church property and revenues fully maintained.

What I wish to point out however, is, that notwithstanding the anxious care of emperors and rulers of the church to protect the property of the church and that of pious and charitable foundations, and to visit every infringement of them with exemplary punishment, there were recognized exceptions in favour of works of charity and benevolence. No matter how sacred the property was, how inalienable it might be declared to be, it might still be sold for the relief of the poor, for the redemption of captives, and for the support of the various charities for the sick and for strangers. And this notwithstanding the dissensions by which the church was disturbed from the numerous heresies that sprang up at that early time. Orthodox and heretic were alike eager to practise the benevolent commands of the founder of their faith, though ready enough to dispute about the terms of the faith itself. That the church was uniformly faithful to this duty cannot be affirmed. At the end of the fourth century, St. Ambrose eloquently advocates the claims of the poor in a strain that

shows they needed an advocate. "The church possesses gold not to hoard, but to spend and apply it for the welfare and happiness of men. Why should we keep that which does no good? Are we ignorant how much gold and silver the Assyrians carried off from the temple of the Lord? Is it not better that a priest should melt it to support the poor when aid is needed, than that a sacrilegious enemy should carry it away? And will not the Lord say, 'Why have you suffered so many needy to die of hunger? You have gold and should give them assistance. Why have so many captives been left unredeemed and slain by the enemy? It were better to preserve living vases than vases of metal.' An answer cannot be given to these questions. For what would you say? I feared that the temple of God should lack ornament? He will answer, the sacraments need no gold, nor does gold satisfy what cannot be purchased with gold. The ornament of sacred things is the redemption of captives, and truly, those are precious vessels that redeem souls from death. That is the true treasure of God which enables his blood to be operative. . . . Nobody can tell why there are poor. No one complains because captives are redeemed. No one can impute blame because the temple of God is built up. No one can be indignant that the earth is opened to bury the remains of the faithful. No one can grieve that there is a rest for the dead in the sepulchres of the Christians. In these three cases it is lawful to break, melt, and sell the vessels of the church, even though consecrated. It is proper that the *form* of the mystic cup should not go out of the church, nor the sacred chalice minister to wicked orgies. Therefore, first vessels are to be sought for that have not been consecrated, then broken, then melted, and distributed to the poor, among the captives, and be an answer to their prayers. And if there are no unconsecrated vessels, I think that *all* may be piously applied to those uses."

A few years later (410) St. Jerome with equal eloquence enforces the same truths. "The glory of a bishop," he says, "is to provide assistance for the poor; it is the shame of a priest to strive for his own wealth. * * Many build the walls and lay the foundations of the columns of the church, statues glitter, the ceilings are resplendent with gold, the altar is adorned with precious stones and there is no election of the ministers of Christ. No one need object to me the wealth of the temple in Judea, the table, the lamps, the censers, the cups, the mortars, and other things made of gold. Those were then approved by God, when the priests slew the sacrifices, and the blood of sheep caused the remission of sins, though they were all but types, but they are recorded for our sakes on whom the ends of the ages have come. But now when the poor Lord has consecrated the poverty of his house, let us bear the cross and value

pleasures as dust. To steal anything from a friend is theft, to steal from the church is sacrilege. We must guard against receiving what ought to be distributed to the poor, and not applying it for the relief of the hungry, to keep back any of it is the clearest crime and surpasses the cruelty of robbers. How can we, crammed with gold, and rolling in wealth under the pretext of pristine charity, follow a poor Christ, and faithfully administer the property of others, while we cautiously keep back our own? A full belly easily endures a fast. It is no praise to have been at Jerusalem, but to have lived there well."

Remonstrances such as these had their proper effect and in 400 the council of Tolletano assigned ¼ of the revenues of the church to the poor; and this seems to have been the general proportion recognized by many subsequent councils and bishops.

HOSPITALS.

Public hospitals for the reception of the sick, the needy, and the stranger began to be erected as soon as Christianity was freed from persecution and could display its natural tendencies without danger or restriction.

Xenodochia, houses for the reception of travellers or sojourners.

Ptochotrophia, houses for the poor.

Orphanotrophia, houses for orphans.

Brephotrophia, houses for foundlings.

Gerontocomia, houses for the aged.

Nosocomia, houses for the sick.

The first mention of a hospital for the poor is about the middle of the fourth century, though they are spoken of as previously existing, they may be considered as contemporaneous with the establishment of Christianity. One of the most famous was founded by St. Basil about 364. And before the middle of the fifth century it is certain that a regular system of providing for the poor in connexion with the church was organized. And we have seen with what care the Emperors encouraged and nurtured all these establishments.

PUNISHMENT FOR CRIMES.

In the year following the edict of toleration (314) Constantine abolished the punishment of crucifixion, and the next year that of branding criminals in the face. Of all the cruel punishments inflicted by the heathen world, crucifixion, in its lingering and excruciating agony, seems to have been the worst. It was usually inflicted upon

slaves, but in some instances even Roman citizens had been so put to death. Branding in the face was also a cruel punishment for a crime that did not merit death. The victim throughout life carried on his face the record and the punishment of his crime, and it would be impossible for him to recover the position he had held among honest men, no matter how great his penitence. Constantine also abolished the practice of throwing criminals to wild beasts. He also prohibited the bloody spectacles of gladiatorial combats (325). In the time of the republic the most usual punishment for Roman citizens was the *aquae et ignis interdictio*, which practically amounted to banishment, since it prohibited the use of those things without which life could not be preserved. Sometimes a person was excluded from a specific place but the rest of the world was open to him ; in other cases he was excluded from all the world except one specified place.

SLAVES.

Slavery was a part of the civil constitution of most countries when Christianity appeared ; yet no passage is to be found in the Christian scriptures by which it is condemned or prohibited. This is true, for Christianity, soliciting admission into all nations of the world, abstained from meddling with their civil institutions. But it is not consistent with many principles and precepts, which cannot have their full effect while slavery exists. Slaves had no rights. They were not so much persons as things, while Christianity teaches the equality of all men before God, recognises slaves as brethren, and inculcates the duty of kindness and benevolence towards them. The Roman world was full of slaves. The Roman jurists scorned the idea of any inequality of race as justifying it, but maintained the right of making slaves of captives taken in war, who might have been killed by the victors,—and following out their legal principles, the child of a female slave must also be a slave. Criminals guilty of heinous offences might be sentenced to slavery ; and a debtor unable to pay might sell himself or his children as slaves. The condition of slaves was a very degraded and sad one. Their masters could kill them without apprehending any punishment. In the course of time the extreme severity of the masters was gradually restrained. They were prohibited to kill them, and their cruelty was checked by judges appointed for the purpose. They were not permitted at their pleasure to order them to be cast to the wild beasts. The emperor Hadrian forbade to kill them, and Marcus allowed them to bring accusations against their masters. The prefect of Rome and the presidents of the provinces, took cognizance of the crimes of slaves. Yet, if from immoderate chastisement only, a slave died under the blows, or oppressed with illness was unable to resist

their force, the master could not be charged with homicide, if it were not done feloniously. But Constantine, now imbued with Christian doctrine, considered that a difference ought to exist, which he embodied in two constitutions, (319, 326). He did not wish that every chastisement of a slave should go altogether unpunished, on account of which he had died, any more than a murder. Therefore, he distinguishes the different kinds of instruments of punishment, which all were formerly used with impunity, and also tortures. Thus, if a master beat a slave with rods or whips, which was the usual kind of servile castigation, or with severer scourges, or put him in chains for safe keeping to prevent him from running away, and he should perhaps die, the master would be entirely secure. Entirely secure, because no distinction was made whether he died under the lash in the hands of the master, or after an interval of one or more days. Differing in this from the Mosaic law, and also from the Roman law, by which one could not be charged with homicide if the person beaten or injured died after some days. Constantine allowed the master to be secure, though the slave died under the chastisement, if only rods or whips were employed, because from the mode of punishment it could not be inferred that the master intended to kill, as when masters correct the misdeeds of their slaves they wish to make them better, and that it is against the masters interest to kill their slaves. But if the master kill the slave with a heavy stick, or a stone, or a javelin, or should subject him to the cruelties of torture, to claws, nails, or red hot metal plates, or to the rack, and the slave expires under the torture, Constantine declared the master guilty of murder,—that from the kind of instrument used the intention to kill was inferred. All these kinds of punishment were used upon slaves before the time of Constantine. These laws were passed with a view of improving the manners of the Romans, and inducing them to be more humane. The Christian writers of the time also inculcated humanity on masters.

With the same design Constantine provided many ways by which slaves might gain their liberty (319). Thus if one manumitted the slave of another before a Judge, or by the order of the Emperor, he was subject to no punishment. But if he had deceived the Prince then he had to give two slaves of the same age and education to the master and three to the Prince. But if the matter was not questioned for 20 years the slave might protect himself by prescription, and his liberator would be free from any penalty. But as a general rule the emancipation of slaves ought to be gradual and under the protection of civil government. Setting at liberty a large number of slaves, probably a majority of the population, not accustomed to exercise the provident foresight of freemen, nor to govern or restrain themselves, is full of danger to the

existence of society itself, and is of little benefit to the slaves. And so we find that soon after the establishment of Christianity, slaves were liberated in such numbers, and, being unable to maintain themselves in a state of freedom, were reduced to such straits, that unless relieved at the public expense, and received into the houses for strangers, and into the hospitals they would have died of hunger. And when these houses could not contain them all, they thronged the highways, and sustained life by begging, the Emperor Valens was compelled by an edict to restore a great part of them to slavery.

The instances I have given are enough to show that Christianity exercised a very considerable influence on legislation,—that it was a beneficial influence,—that it tended to soften the manners, to foster benevolent institutions, to cherish compassion for the poor, the weak, the helpless, the aged and the sick, and encouraged men to imitate the example of its founder by going about doing good.

CELTIC, ROMAN AND GREEK TYPES STILL EXISTENT IN FRANCE. WITH NOTES ON THE LANGUE D'OC.

By Arthur Harvey,

Delegate of the Canadian Institute to the Montpellier Congress of 1890.

(Read 13th December, 1890.)

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2. The Celtic survival in Brittany.
3. Survival of Goths and Iberians in the Pyrenees.
4. Troglodytes in S. W. France.
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6. Report on the Montpellier Congress of Romance Philologers.
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9. Roman remains and survivals at and near Nimes.
10. The Greek Type, with the history of the settlement of Marseilles.

INTRODUCTORY.

The University of Montpellier (Mons Pessulinus), was founded A. D. 1289, by Pope Nicholas IV, who united, *in studio generali*, the faculties of medicine, arts and law. Its sex-centennial was celebrated in May of this year and in a becoming manner. Among those invited to the *fêtes* were many men distinguished in literary and scientific circles, so it was thought fit to hold special meetings of the local learned societies. As the Canadian Institute corresponds with the Montpellier Societé des Langues Romanes, we received an invitation to the Congress held under its auspices, and I was honored with the pleasant duty of responding to it. I am thus called on for a Report, and in the hope to make it interesting, I incorporate with it some remarks on the permanence of race characteristics in several parts of Europe: offering also some observations on the Romance language.

THE CELTIC SURVIVAL IN BRITTANY.

We had scarcely left New York, my wife and I, on the *Chateau Lafite*, for Bordeaux, *viâ* Santander, when this question of race-character came up. I asked from what part of France the sailors chiefly hailed. "All from Brittany," came the rapid answer, "*il n'y a que les Bretons qui naviguent.*" I was aware that in our early records, the *cahiers* of the

Jesuits,* the voyages of Champlain, we hear of Bretons and Basques as the only frequenters of our Gulf—and I have often thought that even before Columbus, some of these Bretons, with perhaps a few Icelanders and a stray Englishman from the British Channel, occasionally fished in American waters, without knowing or caring much about longitudes or the rotundity of the earth. But France has so extensive a sea-coast that I was not prepared for such a sweeping statement as the above, "none but the Bretons follow the sea," but on further enquiry I found it true.

These Bretons have been sea-faring folk from the dawning of their history, and we got a brilliant picture of their ways, two thousand years ago, from the masterly pen of Caesar. Let us review the page.

Having at a somewhat advanced age, but nevertheless burning with the energy which springs from the consciousness of supreme ability and the ambition of finishing a great task within a fast lessening tale of years—Caesar, I say, having obtained a free hand in Gaul, had rapidly crushed the emigrating Swiss, absorbed the unsubdued portions of the Rhone valley, driven back the Germans from Alsace and Lorraine, and mastered the country from the Bay of Biscay to the Rhine. So he sent his armies into winter quarters and prepared to journey into Italy, to consult his party friends in Rome.

But he reckoned without the Bretons, then called the Veneti. How could this people patiently see the Roman Eagles grasping on one side the coasts of Flanders with the estuaries of the Schelde and Meuse, and on the other hand those of the Loire and the Garonne? They must shake that grasp or prepare to forfeit their independence. Their country is a hilly, rocky district, broken into deep bays by ocean tides and currents, and by the warm and frequent rains which edge the waters of the Gulf stream. Their towns, we learn, were chiefly near the points of the numerous promontories, and in this (which may indicate that they were intruders on the soil) we may perhaps see some foundation for the etymological idea which connects them with the Northern Wends, though they were Celts in language and religion.

We may perhaps credit them with the capacity to organise an uprising throughout France; at any rate the storm of war broke suddenly out upon the Alps, where Galba had been ordered to secure himself firmly in the mountain passes. With difficulty Galba's legion extricated itself

*Ce páis a été premièrement descouvert par les François bretons, l'an 1504. *Relations*, 1611, chap. 1.

Il est assuré et confessé de tous que les Bretons et Normands trouverent premièrement le grand Banq et les Terres neuves. *Relations*, 1611, chap. 26.

from a host of enemies, who left 10,000 slain upon the field—and then the Veneti began to harass the legion under P. Crassus, quartered on the Atlantic. Caesar postponed his Italian trip, and matured with consummate generalship his far-reaching plans. He did not instantly hasten to the attack, for these people were not to be dreaded on the land, but he sent one lieutenant-general to the Rhine, to keep the Germans and the Belgians quiet, another into Aquitaine to prevent the Pyrenean clans from mustering, and while he ordered the subject provinces to prepare their auxiliary ships, he himself commenced the construction and equipment of a fleet upon the lower Loire.

The vessels of the Veneti are particularly described by Caesar; light of draft but solidly built of the best of oak, and as strong as iron bolts could make them:—somewhat flat-bottomed craft, for they would, at low tide, often lie upon the mud or sand banks of the shallow harbors—high at bow and stern, so as to be comfortable in the heavy seas of the Atlantic and the channel. Iron chains they had, no mere hempen cables. Some few oars they used, but their chief reliance was on their sailing qualities, and, being of heavy burden, they had dressed leather for sails.

The Roman ships were of Mediterranean pattern, with brazen rams with banks of oars, and turrets in their waist, almost as lofty as the poop decks of the enemy's liners, and not only were they manned by a host of rowers, pressed in Provence, but by chosen soldiery who, besides their usual weapons, were carefully provided with boat hooks, having sharp sickles at their iron-shod ends. All the preparations are carried on under the eye of Caesar, and a fleet is thus improvised in a single season.

Early in the spring, indeed, the generalissimo took the field; not waiting for his marine forces. Nowadays, engineers dig their way towards beleaguered cities with parallels and trenches, but Caesar made his way to town after town by dumping earth and stones into the tide-way, damming out the water with his causeways, and raising mounds to a level with the ramparts. When the cities thus were made untenable, the Veneti would bring up their vessels, and removing the people and their belongings, leave but empty houses to the conqueror. This toil of Tantalus lasted all the summer, but finally the Roman fleet was ready and the rivals met for the decisive encounter with over 200 vessels on each side. The *rostra* were plainly all but useless against the stout Breton craft; the Roman darts were of less avail than usual, for they had to be hurled upwards, but an inspiration seized the Roman admiral, for, as the wind was light, he signalled that the shrouds and the main

braces of the enemy's ships were to be cut with the boat hooks and boarders called out in every instance of success in this manœuvre. To avoid this and escape the terrible short sword of the legionaries, the Veneti wished to keep the open sea, and pointed every prow into the wind—but the stars fought for Caesar that fateful day; the wind completely fell away, and, in the calm, the Romans with their oars were to the Veneti with their useless sails, what a well equipped steam ironclad of to-day would be to an old sailing line-of-battle ship. It was a tale of eight hours' slaughter, the poor Veneti had no chance whatever of escape; by night-fall they had no fleet left to succor their beleaguered towns, and as almost all their fighting men were slain, they surrendered; their senators were all put to death, the rest of the people sold for slaves. Still, there must have been a remnant left, for Charlemagne had to fight one or two severe campaigns against the Bretons, and in every naval war since then, they have been, so to speak, on deck.* Cartier was a Breton, Hervé Riel the same, and even to-day "*il n'y a que les Bretons qui naviguent.*"

Captain Olivier, of our steamer, was a Breton—witty, affable, a lover of literature and science. We had many a discourse about the origin, language and customs of the Bretons. Their Celtic instincts preserve for them a lasting folklore—creatures like the Irish Banshee still exist in Brittany—lingering about their menhirs (stones erect) and dolmens (flat stones) of which, as in every country once Celtic, there are many. And Capt. Olivier told me that having once been in Wales, he had found Welsh terms quite intelligible to him, who then spoke Breton well. At one time, within his memory, Breton was spoken in the public markets of Brittany by preference, French being still a foreign language. Now every one speaks French, though many are still familiar with the old Celtic speech. Of one of our exchanges, the Proceedings of the Breton Geographical Society, with head quarters at L'Orient, a Breton motto, EVIT AN DESKADUREZ AC AR VRO, adorns the cover. Rev. Neil MacNish, B.D., LL.D., of Cornwall, one of our members, translates this, "For the instruction of the country." Lieut. Col. Quoniam, secre-

* I am bound to say, however, that in the meagre accounts of the campaigns of Charlemagne left to us, I have found no traces that the war was a naval one. In the severe campaign of Charles the Bald against the King of Brittany, the principal battle was won by heavy armed French horse against light armed Breton horse. It was fought on the marches of Brittany—one might really say the marshes. The account given carries an addendum that immediately thereafter, the King of Brittany went to the channel, and piloted the Norsemen around the coast to the mouth of the Loire. I also find statements that those Bretons were encouraged by their kinsmen in Wales and Cornwall, and they must have been seafaring folk for such events to be possible. The borders of Brittany, with the marches, were more extensive than the province of later days.

tary of that Society, renders it, with a shade only of difference. "Pour la science et le pays."

It is to be expected that Breton will, in a few generations, disappear —as Cornish, a cognate speech, has disappeared from the opposite peninsula.

SURVIVALS OF GOTHS AND IBERIANS IN THE PYRENÆAN VALLEYS.

At Satander, in Spain, another local type was found. We were told by the French officers of our steamer that we should find at this well-known port the Spanish women loading and unloading vessels, while their husbands would be lying about in the sunshine, smoking cigarettes In a manner this was true. Such women are in Spain, but scarcely Spaniards. Only in Santander and Bilbao are they to be found. They are not Basques, but seem to be a peculiar people in many ways. At these two ports, large quantities of iron ore are shipped in steamers for English ports. The ore is brought down on railway cars to the ship's side, and carried by women, in baskets, on their heads, to the vessel's hold. Men shovel the ore into the baskets and often help to lift them upon the women's heads. Fine, tall women they are too, of erect bearing; skirts tucked up; a coarse sacking used for a shawl or an apron, for the ore is ochreous and dirty. The weights they carry ar heavy, but they work with a will; it would be a hardship to change the system suddenly. One day we climbed to the Exhibition grounds upon the hill, and on the sands of the upper harbor (the tide was out) we saw hundreds of people, seeming very small from the height at which we were. I thought they were picking up shellfish or seaweed, and to know the reason of the assemblage, asked a couple of Spanish women who were there what it was all about. They pointed to the railroad in course of construction along the shore. Men were loading sand into baskets, which women were carrying on their heads to the embankment. I could but smile as I thought of Manning, Macdonald & Co., or Conmee & Middleton, making out a pay-sheet for a lot of women, doing the work they could here do with steam shovels. But the fisher folk in the north of Scotland are no better; the men have done their duty when they bring the boats to shore; the women carry the creels of fish to market and all over the country side. I wish I had had time to ascertain the ethnological characteristics of these people. They belong, I should suppose, to some very ancient stock.

The French consul at Santander, a distinguished *savant*, told me that in no place did the populations of neighbouring districts differ more than in the north of Spain, which is mountainous, the main chain

running parallel to the coast, but sending down spurs enclosing valleys which are cut off from each other by the sea. One of these valleys he said would be inhabited by a swarthy, dark-eyed clan; the next by a fair-haired, blue-eyed race. The former, he supposed, were the ancient people of Spain, driven north by Roman arms; the latter Visigoths, who had taken refuge from the Moors. I did not ascertain if there were any differences in dialects, folklore or customs. The district is an isolated one, and so out of the way of ordinary ethnologists that it has been neglected.

Attention has been given to the Iberians, Aquitanians or Basques, that curious old race who clung to the Pyreneean slopes and the vicinity of the Bay of Biscay, but as I have nothing new to say of these I merely note their existence, a people whose origin is as yet quite obscure; pre-Aryan it would seem; their language so peculiar that our Mr. Chamberlain (whose familiar face we sadly miss, and of whom we all expect a distinguished career among the literary men of the United States) busied himself in tracing its analogies with Esquimaux!

TROGLODYTES IN SOUTH WESTERN FRANCE.

Leaving Santander, and the snow-tipped mountains of the Spanish coast, we crossed the Bay of Biscay to the low lying, sandy and gravelly shores of France, and entered the Gironde, a noble river, muddy as the Mississippi at its mouth. As we approached the Dordogne, the shores began to rise, and near Blaie the north bank is a cliff of soft rock, where I was surprised to find a race of troglodytes. For a couple of miles or more there is a continuous settlement, one can scarcely say a town or village, of these people, and the appearance of the spot is very peculiar and picturesque. I asked in Bordeaux, in Paris and in London for photographs of the locality, but the enterprising camera man has not been there yet. In the rock face a door is cut; a room is hollowed out behind, then perhaps another, a chimney is pierced through to the top, a window chiselled out beside the door, and the house is ready. I saw in several cases one house above another, and there the chimney would be built up outside the cliff. Some of the house fronts had an attempt at architectural ornament, a rude cornice or frieze or architrave over doors and windows. The stone is now an article of commerce; it is cut and taken to Bordeaux and other places. I saw parts where quarries had interfered with the houses, exposing the interiors. It seemed that the rooms had been well squared and were of a good size. The rock is very easy to work, it can be carved with a stout knife, there is a road-way, or at least a good path-way on the *talus* at the foot of the cliff, by which

every door is accessible. I do not see that these dwellings are inferior to those of people of similar class in any country, even ours. On the Gironde, they all face south-west, and where the Dordogne comes in from the east the cliff is cut by that stream and the cave-dwellers' habitations extend up the north bank, thus looking south. I suppose the same formation runs up to near Tours, for in a paper given to the *Globe* by our Dr. E. A Meredith, in 1888, he notes the existence of cave-dwellers in that locality. Dating his letter from Vernou, he says he saw

"huge black openings in the horizontal ridge of white rock, high up in the side of the valley fronting us. What are they? Well, these are the mouths of some of the famous caves for which Vernou and the neighbouring region is celebrated. Caves tenanted by human beings. * * * But let it not be supposed for a moment that these troglodytes are necessarily on that account objects of commiseration; on the contrary, after inquiry and personal examination of several of the cave-dwellings, I am quite satisfied that the subterraneous inhabitants of Touraine, if I may so describe them, may well be envied by the peasantry of many other countries. * * * They are warm in winter and cool in summer * * * considered remarkably healthy * * in no part of Touraine are there so many instances of longevity as among the tenants of the caverns. * * * Operations connected with the pressing of the grapes and the making of the wine are carried on in the caves * * which, from the evenness of their temperature, make most admirable wine cellars. * * * The owner of one of the caves which I visited, a three storeyed dwelling, told me very naively that during the late Franco-Prussian war, when the German army occupied the country for several weeks, he hid himself and his belongings for eight or ten days in the back part of the cave, which extended more than 150 feet into the rock, having carefully stopped up the cave some twenty feet from its entrance. * * * Like commonplace habitations they are endless in variety. * * Some are nothing but simple openings into the rocky limestones, without door or window. Others again have good doors and windows set into the solid masonry built on to the rock, with chimneys protruding through the sides of the cliffs like an incrustation or growth upon the rock, while elsewhere the masonry forms a large annex to the rock behind it, and finally the dwelling house proper is built quite separate from the rock and the caves are used simply as outbuildings or cellars for the inhabitants. * * * The deepest of these caves, which I myself examined, was probably 150 or 200 yards in length, opening out considerably as we advanced inside the rock, but this depth is greatly exceeded in some cases. Indeed I was told that there were caves whose extent had never been ascertained."

After many other interesting paragraphs, Mr. Meredith says:—

"As a rule these cave habitations are occupied solely by the peasantry, but to this rule there are occasional exceptions. One of the caves not far from my hostess' house was occupied by a lady of some means, who had furnished her cavern very well and made herself very comfortable in her rocky lodgings. In the preceding winter, however, the weather had been unusually severe, and she had found her efforts to raise the temperature of the cave by fire almost altogether useless, the constant fires producing but very inappreciable results. Of the origin of these caves we have said

nothing. Tradition assigns their origin to the old Romans. * * * * When I bade good-bye to Vernou, took the railroad from Tours to Bourges and on to Bourn, I was not a little surprised to find all along the low ridges of limestone hills which skirt the railroad, a similar series of endless caves. * * * The mayor of Vernou informed me that in his canton alone there were no less than 1000 dwellers in caves."

THE LANGUE D'OC.

We had ample time to see the beautiful and interesting city of Bordeaux, but as I am not writing an itinerary or traveller's notes on general subjects, I will pass over the vine covered plains of the Médoc region, the prune orchards of Agen, the cornfields of Toulouse (where maize has taken for a time the place of the vine, destroyed by the phylloxera) and come at once to Montpellier, a beautifully situated city in sight of the mountains on the one hand and the Mediterranean on the other; a city like many others in France, encircled by walls, once its strong defence, now only a constraint; a city with some new, broad streets and houses of modern architecture, but more interesting to me in the older quarters, where the streets are winding and often steep, where you can sometimes almost stretch your arms from one side of the *rue* to the other, with "bits" that would delight the sketch club, at every turn. As you go east from the humid air of the Bay of Biscay—humid, but so warm that they have in the gardens at Bordeaux a lovely grove of palms—the climate gets drier at every stage, and before you reach Montpellier you see signs of a change in vegetation, while by the time you get to Nîmes, mulberry trees, lemons and figs are common, and the olive shares the chief honors with the vine. It was in Montpellier that we first noticed the soft Provençal speech. We used to go to the public markets, whenever we had the chance, deeming that we could learn much there about the habits and resources of a country. We looked with some astonishment on the raw cuttlefish sold in Santander, such as Lucian sneeringly says, Diogenes died from swallowing; on the minute subdivisions of the poultry at Bordeaux, where you could buy a single leg of a chicken, or the fly bones of the wings, or the white meat of the breast, or the bony skeleton after legs, wings and breast had been cut away—valuable, of course, for soup. At Toulouse we saw the curious collection of second hand things dealt in by open air vendors in the cathedral square, which marked the poverty of that stricken district—but we heard French everywhere, and every enquiry was politely answered in that language. At Montpellier, however, we were nonplussed. The fine Mediterranean lobsters, lacking the great nipper claws of ours, the red mullets, the slices of tunny, the Japanese apricots the fresh lemons, the olives salted in tubs, the profusion of flowers were

charming to see, but our enquiries were checked—we did not understand the jargon of the markets—and it slowly dawned upon us that we were among those who still used the Langue d'oc. Here let it be permitted to take a rapid glance at the origin and growth of the Romance language generally, that we may the better understand the position of Provençal and kindred dialects.

We have in Toronto a society for the study of the Romance languages, and it would not surprise me were some of its members to say that the French, Italian, Spanish, etc., which they aim to become conversant with, have developed directly and independently from the Latin of Livy and Virgil, Cicero and Caesar. Yet this is scarcely the case. The Latin speech of the Romans was, I imagine, at no time the common language of all Italy. In the Latinity even of Cicero traces are found of a lapse from the earlier idioms ; for instance, in the use of *habeo* as an auxiliary in conjugating the verb. In Plautus we find, in every page, evidences that the standard of ordinary conversation differed much from the written lines of say Horace or Tacitus. The terrible work in the continuity of the literary record, made by the Christians,* the tribes of northern Europe, the Tartars, and the Mussulmen, who were instrumental in the decline of the Roman Empire, prevents our following step by step the degradation of the old and the development of the new language: we therefore have to accept and reason from such traces as are left, just as from fossils we must, despite the imperfections of the Geologic Record, try to write in full the history of the development of organic life.

The earliest statement to which the authorities attach much weight relates to a very short speech indeed. A little before 600 A.D. the Greek Emperor Maurice, having made a treaty with the Franks, with the object of attacking the Chagan of the Avars, entrusted the conduct of the war to Commentiolus, who had previously been successful against the Goths in Spain, taken Carthagena and lived there for some time. We cannot tell whether the soldiery who followed him were chiefly Goths or Franks, but on the march a sumpter mule fell down, and the men who saw the accident shouted to the muleteer, who was a long way in advance :—

Τῇ πατρῴᾳ φωνῇ. Τόρνα, Τόρνα, φράτρε.
—*Theophanes. Chronographia.*

Ἐπιχωρίῳ τε γλώττῃ. . . .ἄλλος ἀλλῳ, ῥετόρνα.
—*Theophylact, His. lib. 2, cap. 15.*

The shouts produced a panic among the troops of Commentiolus, who fled

* *e.g.*, Gregory the Great had all the copies of Livy burned which could be any where discovered—an action which St. Antonine describes as honorable to his memory !

precipitately ; the noise alarmed those of the Chagan, who turned tail also ; both armies thus ran away from each other. Perhaps the story is intended to reflect discredit on Commentiolus, whom Gibbon describes as "the object of satire or comedy rather than of serious history." However, its interest for us at this moment is in the facts, *first*, that the soldiery are said by the Greek historians to have spoken *in the language of their country*, and *second*, that this language is *no longer classic Latin but Romance*. In Latin, I need scarcely hint, there is no such word as "Torna" or "Retorna" ; no such vocative as "fratre."

Now Raynouard says,* adverting to the irruption of the barbarians, "The admixture of those peoples, who gave up their barbarian speech and adopted that of the conquered races, owing to the need of sharing their religious, civil, and domestic relations, was necessarily fatal to the Latin language, and its decadence was rapid." Raynouard is a great authority, but the date of his work is 1816. Present views differ. Gaston Paris,† for instance, says of the Romance tongues, "We speak Latin and nothing but Latin." He even forbids our repeating "The Romance languages spring from Latin." For myself, I fail to see in those Romance tongues which I have studied much barbarian influence. I agree with Mr. Gaston Paris that the local forms of speech throughout France shade insensibly into each other. I believe he might extend the statement beyond the limits of France into Italy, Spain, Flanders and Switzerland, and into all the past ages as far as that of Augustus. The example we have in the Province of Quebec is very striking, where we have a French with pronounced Norman characteristics, but the English, Scottish, Jersey immigrants . . . what trace of their mother tongue have they left to their descendants? None! The English words in use in our sister Province have quite another origin and reason for existence. I do not think the new speech of the western Roman Empire was a degraded Latin—it was really a developed and developing language.

By the time of Charlemagne, two centuries later than Maurice, Latin had disappeared as a spoken language, and a new tongue, with a new grammar, had taken its place. To express the relations of nouns, prepositions had replaced inflections—De for the genitive, Ad for the dative. The rules of declensions were no longer followed, and the endings of cases fell away as useless—Duc for ducem ; veritat for veritatem : exil for exilium ; Hom for Homo ; styl for stilus ; arbre for arborem. So with adjectives—Just for Justus ; un for unus ; visible for visibilis. Also

*Choix des Poesies originales des Troubadours—1816.

† Les Parlers du France—1888.

with pronouns—il for ille ; jo, jeu, eo. eu, for ego ; mi for mihi. For examples :—

Molt fort blasmava Boecis ses amigs,
(Boecis blamed his friends most strongly.)

De sapientia appellaven doctor.
(They called him a master of wisdom.)

Las mieuas fedes auzon la mieua votz.
(My sheep hear my voice.)

Now Charlemagne's empire extended over France, adjacent parts of Spain and Italy, Holland and Belgium, and no inconsiderable part of Germany. His court was mainly held at Aix-la-Chapelle, in Rhenish Prussia. So lost in his dominions was the Latin of the classics that he had to bring from Rome persons who could teach the Latin grammar! We have however an account of a Spaniard who, having contracted a serious illness by bathing in the Ebro, went on a pilgrimage to various churches in France, Italy and Germany. At Fulda, in Hesse, he was cured and the priest conversed with him without difficulty, "Quoniam linguæ ejus, *eo quod Italus esset*, notitiam habebat." Still even at that time a differentiation had set in. We may take the Romance language of the epoch as that to which French, Spanish, Italian, etc., owe their being, but Eginhard, Charlemagne's secretary, chancellor and biographer, excuses his poor Latinity, as being "little versed in either Romance or Latin"; his idiom being Frankish (francisque, francique, théotisque), that of Aix and vicinage. Romance was so firmly established that Charlemagne had edicts published and church services conducted *in lingua rustica Romana*, and after his death, when the empire was divided, Lothair published the treaties *in linguâ théodiscâ*, Charles the Bold and Louis *in linguâ Romanâ*. The oaths taken by the people were sworn both in Frankish and Romance. Fauchet* says, "may we not conclude that the language of these oaths, which Nithard calls Roman, is really Latin, but quite like that which the Provençals, the Catalans or the people of Languedoc use at this day?"

We soon get upon firmer ground, for we approach the golden age of the new tongue, and the three extracts I will translate will complete what I wish to say of its history :—

1. Huot says : "The Romance language was called Provençal, not only because it underwent fewer changes in Provence than in other districts of France, but also

* Recuœil de l'original de la langue et poesie Française.

because the people of Provence commonly used it in their compositions. The troubadours and chanters, the tellers of stories and the conjurers of Provence—in fine, all who followed 'the gay science,' began, from the time of Capet down, to romance to good purpose, inditing their tales and novels in the Roman language, *for the Provençals* were then *more versed in literature and poesy than all the rest of the French together.*"

2. L'Abbé Lebœuf states that "in most of the provinces of Gaul a language was commonly spoken very similar to that of the Provençals, and *it lasted until the trade of the northern Provinces* with the Germans, and of Armorica with the English, *caused* towards the eleventh century *a harshness which did not previously exist.*" Thus we find the Françisque idioms re-inforced and perceive the origin of modern French, which has probably prevailed over Provençal because, the seat of the French kings being in the north, at Paris, public documents were edited in the northern forms."

3. The authors of the Literary History of France tell us very clearly, "*After this date we must distinguish French Poetry, properly so called, from Provençal*; the genius of the latter tongue remaining almost pure Roman, while French, although pure Roman in its origin, was gradually changed, as much by new inflections and terminations as by other improvements which brought it into harmony with the French spirit. This was the tongue which the poets north of the Loire chiefly used; those to the south of it rhymed in Provençal."

Now from Genoa to Carthagena, Romanesque dialects are still the mother tongue of the common folk. They are still so allied that the intimate relationship is perceived by even the illiterate, who can understand them without much difficulty. There seems to be a somewhat marked division at the Italian frontier on the one hand, and at the Spanish frontier on the other. The Genoese dialect verges more on the Italian language; perhaps in appearance rather than in fact, because Italian orthography is used in spelling it. Then we have Vintimillioso, Mentonasque, Monégasque, Niçois, Provençal proper, langue docien, Montpelierien, Toulousain, Cevenois, Gascon, Rouergat, Lozerien, Dauphinois, Auvergnat, Limousin, etc.,* and a number of Pyrenæan dialects. Passing the Pyrenees where again the Spanish spelling gives a different look to similar words, we get Catalan, which merges into Spanish proper. The people of the heart of Languedoc speak of the French language as a foreign and intrusive one; they call it "Franchiman." It is but recently that the Government has resolved that instruction in the Public schools must be given in French, and has prohibited the use of Provençal in the school premises.

These local dialects are largely meant when our correspondents in

* Many of these being collectively called "Gabachs."

Europe speak of the study of the Romance tongues; these and the archaic forms in which old charters, old laws, old poems are written.*

REPORT ON THE CONGRESS OF ROMANCE PHILOLOGY.

The Congress of Roman (or Romance) Philology was called to order in the principal lecture room of the Faculty of Arts in the university buildings and was attended by delegates from the Universities of Bologna, Fribourg, Copenhagen, Helsingfors, Groningen and Upsala; also by numerous *savants* from universities in France, by the Bishop of Montpellier, the general in command of the division, the member for the constituency, a good delegation of the professors and students of the University of Montpellier, and the members of the Council of the Society for the Study of the Romance Languages. Mr. F. Castets, the president of the society, the *doyen* of the Faculty of Arts, took the chair; Mr. E. D. Grand, professor of diplomathy and palœography, was elected secretary. Professors Chabaneau and Rèvillout were chosen vice-presidents. In due time I presented my credentials, and the congress was pleased to honor this institute by inviting me to act as one of its vice-presidents. I afterwards presented to the congress a copy of Abbé

* While preparing this paper, two considerations have been brought back to my notice with greater force than formerly. The first is that spelling is often a hindrance to the recognition of linguistic affinity, especially to an Englishman, whose vowels and consonants are sounded differently to those of any other language. I will instance the Greek *υιός*. We know the ordinary English pronunciation of it—Hwhyos. The Latin filius we sound like file, a rasper, and so miss the connection. But with the soft i and the l *mouillé*, the identity of the two is manifest—*υιός*—filius. And the further analogies of fils, fille, Fitz, Figlio, become clear. The Pyrenean and Bordeaux dialects now use *p* for the initial *f*. The second which is cognate is that when we say English comes from French and German we are hardly correct; it comes from German or whatever else you like to call the Saxons' tongue and from Romance, for Romance was the language of William the Conqueror and his Knights—Romance was the court language of England until France was lost to the English Crown. We found many traces of English arms as far as we went in France. We passed Carcassonne, a remarkable specimen of a mediæval town; its battlements and other defences as they were in the 13th and 14th centuries, kept at an annual expense of 20,000 francs by the French Government. Carcassonne we were told was a maiden fortress until Simon de Montfort took it, but I see it was taken by Edward the Black Prince, and have not had the opportunity to examine the other statement critically, and no one prevailed against it after him; there is a Count de Montfort who has estates in the neighbourhood still. And at Beziers is preserved the book beginning "Aysso es lo libre de memorias, Lo quel Jacme Mascaro * * a fach e hordenat." * * Here is an extract:—"L'an dessus dig—MCCCLVI. @ VIII. del mes de septembres, fouc pres nostre senhor lo rey de Fransa, que aire nom mosseuhor Johan. Et aisso davan la viela de Peyties, don ne fouc tot le rialme en tristor. Et pres lo en batalha rengada lo princep de Galas, filh del rey d'Anglaterra, et pueys menet lou en Anglaterra." So long as France and England were bound together, the Romance languages were used by the commanders on both sides, and many of the English soldiery must have become versed in the same. To understand English then it is very necessary to know Romance both in its grammar and pronunciation.

Casgrain's Légendes Canadiennes, a copy of Gagnon's Chansons Canadiens, our publications on cosmic time, a copy of the Dominion Illustrated with views of our university buildings, a copy of the McGill College Gazette, and a paper on the position and prospect of the French race in Canada, of which I have an English translation which may be read to our historical section, after its publication in France. I will not now quote any detached passages but will give you a table I constructed from our census tables of 1881.

Provinces.	Square Miles.	Population.	Population of French origin.	Per cent. of Fr. origin.
Prince Edward Island.....	2,133	108,891	10,721	10
Nova Scotia	20,907	440,572	41,219	9
New Brunswick	27,174	321,233	56,635	18
Quebec	188,688	1,359,027	1,073,820	79
Ontario	101,733	1,923,228	102,743	5
Manitoba	123,200	65,954	9,949	15
British Columbia	341,305	49,459	916	2
Territories	2,665,252	56,446	2,896	5
	3,470,392	4,324,810	1,298,929	30

When I said it was probable that in a hundred years there would be in the basin of the St. Lawrence and adjacent regions as many French speaking people as there are Frenchmen in France, there was some little of what the French reporters call "sensation."

I cannot think the discussions were important. I was expecting to hear some valuable paper on the increase or decline of the Latin languages, where they are in contact with others ; on the extent to which each of the chief Latin languages has mixed with others; on its nearness in the important particulars of structure and pronunciation to the original ; on the increase or diminution in the use of root words of other origin ; on the prospects of these languages in new fields—America, Africa, Oceania; on their adaptation to art and science, and their uses therein, together with their influence on the peoples who use them, as bringing them near to or keeping them from modern tendencies in science, commerce, and religion. But I am compelled to observe that the main subject of discussion was how the French Government could be best induced to grant a further sum of money for making continued investigations into the dialects or *patois* of the South of France, and by whom that sum should be expended. Professor Tourtoulon, who had received a Government subvention some years before to make a report thereon, had in charge a resolution with this object, but as no report had yet seen the light, and some other persons wished for a share of the public money going, it

led to some discussion. Professor Tourtoulon read a part of a paper (published in full in the *Revue*) in which the question raised was, Are the Roman languages Latin or the daughters of Latin; *i.e.*, are they a natural development of Latin or languages changed by external influences? The Bishop of Montpellier, a charmingly *suave* personage, spoke of an edict of Charlemagne's published both in Latin and *in linguâ Rusticâ Romanâ*, whether the same as that alluded to in Raynouard I did not ask. One of his abbés related having met with an island of Provençal (*un islot*) in the Department of the Isère, that is, a township or two where the people still speak Provençal, while in the surrounding districts they speak French. This he considered evidence that Romance had once existed much further north than now. There was also a paper given on the Courts of Love, of some historical interest. The delegates met with the utmost hospitality from the good people of Montpellier. The President of the Congress, Mr. Ferdinand Castets, was kindly attentive to all, and gave us, at the close of the congress, a charming déjeuner, at which some eloquent speeches were delivered and some friendships cemented, which will last, though mountain chains, seas and oceans now divide those who sat side by side at table—but no collation of news, no appointment of committees was made, no subjects for future observation or reflection were appointed. In short, while some interesting facts were stated or hints given by a few, no organised action, no cohesion was noticeable. I was present also at the congress of the Geographical Societies, and I observed that it too proceeded to resolve (*émettre un vœu*) that the government should be asked to do this and that. There was none of the feeling of independence noticeable here, which leads us to make enquiries at our own cost of time and money; none of the division of labor among committees who are expected to report, and do report, at stated times; no covering a large field by concerted action. And when I spoke of this difference, my friends would admit the fact and lament the weakness in this particular of the French character.

I will mention, as an instance of how small the world is, that at the déjeuner I sat close to Mr. Van Hamel, of Groningen University, a pupil and friend of the late Professor Hoeksema, of that university, who was my school "chum" in days long past! "El mondo es poco; digo que el mondo no es tan grande como dice el volgo" (letter of Columbus to Queen Isabella, from Jamaica, 1503). But I must by no means forget to say that for a short time the congress was honored with the presence of Mr. Frederic Mistral, who was asked, on his entrance, to take a place with the vice-presidents on the platform.

FREDERIC MISTRAL AND HIS MIREIO.

I will confide to you that I knew very little more of Mistral than Mistral did of me, but one glance at the man was enough to arrest attention and challenge enquiry. Alphonse Daudêt says of him somewhere that he unites the strong and supple figure of a Greek shepherd with the natural grace of an Apollo. I applaud, and admit never to have seen a handsomer man in strength, health, intelligence, dignity, kindly good nature, happily blended, and shining from a nobler countenance. The time of the troubadours, the best part of the middle ages, has always had an interest for me—when Europe was being re-organised after the great popular migrations. I have read the fierce war poems and the tender complaints of Bertrand de Born, the Tensons of Gaucelm Faidit, Geoffroi de Pons and others; the sirventes, ballades, Rondes of numerous singers whose names it would be useless to recall. These troubadours led directly to Petrarch* and Dante in Italy, to Gower and Chaucer in England. There is much in common between them and our present Tennyson, in subject and in the swing of their rhythm. The old Greek metres, wonderfully beautiful, do not live for us; we admire in a coldly intellectual manner their mathematical graces, as we scan, with more or less of labor, their schemes of feet. I rather think that even the exquisite Sapphic line, followed by an Adonic, would fail to arouse an ecstasy of enthusiasm in this most cultured audience. The Latin imitations of them by Horace and his followers fall as flat as the originals; the graces of diction and the tersely put together thoughts alone impress us. When these poets of classical times "strike the lyre," they strike it for us in dumb show only, as we have seen actors on the stage pretend to sound the harp or violin while the true music came from behind the scenes. But the troubadours sing in rhyme, which we do still admire—and in rhythm, which, despite Walt Whitman's "barbaric yaup," we yet delight in. It is literally true to say that not one of the recent most graceful forms of English or French verse was not successfully attempted by the troubadours. "*Sabia ben trobar e ben viular et ben cantar*" was said of one; it applies to very many. Still, we had thought the race extinct; that Cervantes and Rabelais had killed the old-style minstrelsy when they gave the *coup de grace* to chivalry, with their finely tempered rapiers of keen sarcasm.

But up comes Frederic Mistral, a Provençal farmer's son, whose forefathers for generations back were farmers or peasants like himself; and in the same idiom, in the same spirit and the same form, sings like

* Petrarch was a student of Montpellier; so, later, was Rabelais.

the old *trouveurs*. His lays are not numerous, he is a young man yet, it would perhaps be as impossible as impolitic to attempt too much of an archaic kind. But for what he has done he commands our esteem and thanks. His longest poem is entitled *Mireio*, and opens thus:—

Across the Crau, to the sea, through the wheat,
Whither love may lead or drive her agile feet
I will follow a Provençal maiden sweet.
As her folks were only farmers, at the plough,
Her tale has not been told far from the Crau
And I follow Homer humbly, I avow.

Cante uno chato de Prouvènço,
Dins lis amour de sa jouvènço,
A travès de la Crau, vers la mar, dins la bla,
Umble escoulan dóu grand Oumèro
Ién la vole sequi. Coume èro
Rén qu'uno chato de la terro,
En fero de la Crau se n'es gaire parla.

The story is exquisitely simple. Mireio, the only daughter of a rich and thrifty farmer, becomes attached to Vincent, the son of an old sailor who lives by making osier baskets. Love at first sight it was. Suitor after suitor for the hand of the rustic heiress appears, only to be refused—and according to the occupation of each, occasion is taken to describe the gathering of mulberry leaves, the mixture and habits of silk-worms, the herding of the local breeds of cattle, the horse-ranching industry, the care of the flocks which migrate from the mountains to the great plains of the Rhone in winter and back in summer time. Even the life of the fishermen on the lagoons and on the inland sea of Provence is described in verses which remind one much of the Virgilian Georgics. The girl's parents at last discover the cause of her refusing eligible *partis*, and forbid her seeing or meeting her true love again. Meanwhile this youth's mind is much disturbed; he knows he is poor, but he is strong and active; he leads in the local races; he beats in fair fight upon a lone hillside a young giant who was angered because *Mireio* had refused him, though when the giant is allowed to rise he treacherously stabs the youngster with an ox-goad and leaves him for dead, when passers by carry him to *Mireio's* farm, and thus and there the secret of their love is shewn. Finally he persuades his father, as the only way to preserve his health and life, to call upon *Mireio's* parents, tendering his life's devotion, and double service on the farm. The interview between the two old gentlemen is beautifully told, and when finally the rich farmer taunts the basket-maker with his poverty, the latter indignantly derides mere wealth, and well describes his services to France. Now *Mireio* had been told by her lover that in the last extremity, she should at the shrine of the Three Maries invoke their aid. The little church is miles away, but, driven to desperation by her parent's

objection to her first and only love, weak from the illness which has confined her to her room, she leaves her home, alone, at night; she crosses the plains of La Crau, helped on the way by a fisherboy who ferries her across the Rhone, and, half-famished and blinded by the sun which beats too fiercely on her unhappy head, she faints as she reaches the church, when in a trance she sees the Three Maries, who calmly and benignly speak to her, and give her their divine and saintly comfort. She is carried from the crypt to the sacristy. Her parents, who have called all their dependents to aid their search, and have followed her traces, now arrive, also her lover, who has surmised where she would be. Their pride relents before such evident affection, suffering, and devotion, but too late; the hot sun has struck the troubled brain too fiercely, and with the light of her heavenly vision in her eyes, and her lover's kiss upon her lips, her soul takes wing.

This charming poem had not even seen the light when a translation was demanded, and it was republished, with a literal rendering into French, and a dedication to Lamartine. Since that time it has become known to all the world, and there are, I find, two English translations in our Public Library. From that of Mr. M. Crichton I will quote one of the songs—given at a rustic gathering at *Mireio's* home—prefacing it with a few words only. It was common among the Greeks* to compose poems in which two persons spoke to each other a verse in turn. The Romans copied this practice, and perhaps the best known Latin example is the Horatian "*Donec gratus eram tibi*," which has been translated by many English scholars, including Professor Goldwin Smith.† Among the Troubadours this form was so usual that it was called a *Tenson*, probably from the Latin word *contensio*, and thus, you see, Mistral is strictly in the line of the Troubadours. We ought to call the lay an *aubade*, not a *serenade*, and Mistral does so call it, but the translator has used a word which the English better understand, for in these days of gas such airs are thought of as evening melodies, not as early matin-songs.‡

* Theocritus, Idylls.

† Et cantare paves, et respondere parati.—*Virg., Ecl. VII.*
Incipe Damœta, tu deinde sequere Menalca
Alternis dicetis; amant alterna Camœnæ.—*Virg., Ecl. III.*

‡ In 1854, an association was formed to preserve the language of Provence and the South of France; also to honor the present and past poets and other celebrated men of that region. The members of this association are called Félibres, and the union is called the Félibrige. "La Félibrige," writes Henry Fouquier, "est un mouvement uniquement litteraire * * pour sauver les langues locales du Midi. Sept poêtes, dont les trois plus celèbres sont Mistraı que tous ont lu, Aubanel, Hunel et Chenier provençal et le satirique Roumanille—*eapoulié* actuel—se rèunirent pour défendre et propager la vieille langue provençale, dont ils ont donné la grammaire et le dictionnaire, en même temps qu'ils s'en servaient pour ècrire leurs poèmes, érudits et poètes tout ensemble. Ils prirent le nom de félibre si doux et si vibrant, qui signifie poète, sage, maître."

MY DARLING.*

O Magali, love's model maid,
Accept my modest serenade,
List from thy window, not unseen,
My violins and tambourine.

He: With robe of stars the sky's still dressed,
The winds have rocked themselves to rest,
But when thou liftst thy window veil
At sight of thee, the stars will pale.

She: Thy serenade's no more to me
Than is the murmuring of the tree,
But to the sea-kissed rock I'll steal
To hide beneath, like silver eel.

He: O Magali, if thou become
The denizen of wat'ry home,
I'll be a fisher, night and day,
Until I claim thee for my prey.

She: If thou art fisherman, and cast
Thy net to search the waters vast,
Meanwhile I'll turn to bird, and hide
In distant lands, unknown and wide.

He: Oh Magali, if thou should'st change
To bird that beats the airy range,
I'll learn and ply each art and lure
That my sweet quarry can secure.

She: While for young partridge thou shalt beat
Or spread thy toils, the lark to cheat,
I'll turn to flowering herb and cower
Where meadows broad shall form my bower.

He: Oh Magali, if thou put on
The daisy's pied caparison,
A limpid streamlet shalt thou see
Curl round thy feet to water thee.

---

* O Magali, ma tant amado,
Mete la tet 'au fenestroun,
Escout un pau aquest' aubado,
De tambourin e de viouloun.

Ei pleu d'estell' aperamount,
L'aur es toumbado,
Mai lis estello paliran,
Quand te vèiran.
etc., etc.

She: If thou the waters' nature take,
Myself a flying cloud I'll make,
And sail away, beyond thy ken
To lands of other climes and men.

He: Oh Magali, if thou would'st fly
To distant land of other sky,
I'll be a chariot of the air
And carry thee triumphant there.

She: Art thou the gale that flings the spray?
I'll take my flight another way,
I'll be the all pervading sun
That thaws the ice it shines upon.

He: O Magali, if thou absorb
The essence of the solar orb,
The salamander will I be
And drink all day full draughts of thee.

She: If thou the form of lizard wear
That in the thicket makes its lair,
I'll be the far off Queen of night
While witches dance beneath my light.

He: Oh, Magali, if thou should'st be
The moon in her full majesty,
I'll be the soft and silken haze
And weave a prison round thy rays.

She: If thou with mist would wrap me round
Not in thy net will I be found,
I'll be the virgin rose, and blush
To hear my praises from the thrush.

He: O Magali, if thou assume
The mantle of the roses bloom,
I'll be the joyous butterfly
And kiss and sip thee till I die.

She: Nay, rash pursuer, though thou run
With wingèd speed, thou'lt be outdone,
For in the forest thick and dark,
The oak shall lock me in its bark.

He: O Magali, adoptest thou
The oak that climbs the mountain brow,
I'll turn to loving ivy vine
Round trunk and branch my arms to twine.

She: And when thou think'st to clasp me round,
A withered trunk wilt thou have found,
A pensive nun I'll vow my days
To blessed cloister of St. Blaize.

He: Oh, Magali, if thou espouse
The cloister life, with holy vows,
Then I'll put on the priestly dress
And hear thee all my wrongs confess.

She: If thou within the convent gate
Shalt think to share my holy state,
Thou'lt see the nuns around me crowd
And, weeping, fold me in my shroud.

He: O Magali, if thou defy
My constant search, and early die,
I'll be the earth, and in my breast
Will clasp thee in thine ever rest.

She: At length my faith begins to turn,
Now speak'st thou well, and not in scorn:
My crystal ring, sweet youth, then take
And wear it for the giver's sake.

He: O Magali, I'll live for thee
Since thou dost give such life to me
But, since thou hast thy charms unveiled,
Oh! see the stars, how they have paled.

—*Translation of F. Mistral by M. Crichton (1868).*

Now this is the Mistral who, entering the hall and taking a modest seat on the floor, was noticed, and with general acclaim called to the place of honor. He was asked to explain his views on the subject under discussion, and went to the root of it at once. He disallowed the word "patois" as applied to Provençal—he said he could not object to the use of French in the schools, in teaching ordinary subjects, but the use of Provençal in conversation should not be proscribed, Provençal teachers should not be dismissed for conversing with their scholars in Provençal, nor should Provençal lads and lasses be punished for using their mother tongue. A proscribed language would be thought an inferior one, and why should Provençal lads be made to think meanly of their origin and their race, of which the traditions were so noble? Provence had been the home of civilization when the rest of France was barbarous; rural Provence was far more civilized yet than the inhabitants of Frenchified and modernized towns. Compare the hospitality, courtesy, ability to converse intelligently and fluently, of the mariners, shepherds, fishermen

of Provence with the factory or shop-keeping populations. Bah! they were not to be mentioned in the same breath. As for civilization, what was it but the possession of many and clear ideas? Ideas, he thought, depended upon the words at command to express them. There were several thousand words in Provençal for which there was no exact French equivalent, while for many names of curious flowers, insects and birds there could never be French names used, while the Latin ones used by naturalists were unmeaning to the common folk. *Plus de mots, plus d'idées.* Therefore it was better to have the two languages, and in proscribing Provençal, the Government was doing a distinct wrong to the mental standing of the southern people. In a very few generations this interesting language would die out.

Mr. Castet's opinion was, That the popular speech had endured long, and that it would take ages to disappear.

I asked if there was any real hostility in feeling between the North and South of France; any bitterness at the evident desire to unify the language of the country. Mr. Brèal told me "not at all; that every body except the literary men who lived by the Romance language, and some of those who loved it as their mother tongue, thought the Alpine and Gascon *patois* ought to be disused, but no harsh measures taken to destroy it."

SUNDRY MONTPELLIER ITEMS.

At the Congress of Students of the Languedoc, one of the resolutions called for the introduction into the primary schools of translations from the Languedoc into French, for making a knowledge of the Languedoc, Basque, Rousillonais or Breton (according to locality), a *sine qua non* of the teacher's appointment and of the scholars' certificates. They wished French to be taught by means of the langue d'oc. But these proceedings, like those of our own Congress, had a somewhat hollow ring, the people did not seem to be more than half in earnest, and I may say the same of those connected with the placing of a tablet on the Tour des Pins (part of the old walls which dates back to the 12th and 14th centuries) "To the memory of James I. of Arragon, son of Mary de Montpellier," the rest of the inscription being in Montpellierain of the 13th century. I transcribe it :—

En l'an MCCVIII e lo I jorn de Febrier, nasquet en aquesta ciutat
en Jaumes I lo conquestaire, Reis d'Arago
coms de Barcelona, senher de Montpeslier
aquel que pres Tres reialmes als Sarrazis
Donet Justas leis a sos pobles, amparet los mesquis
assostet los lauradors, los mercadiers, los savis els trobadors
Renonciet per amor de sant Loyse de la reyna Margarita
als dreigs de son linhatge sobre gran part de la lengua d'oc
e de la Provença, e mori a Valeusa D'Espanha, lo xxvi de Julh
MCCLXXVI

The invitations to the dedication of this tablet are officially said to have elicited replies which "glorified in abundant and eloquent terms the history of Languedoc, and recalled the ties of fraternity which unite it to Aragon and to Spain." One clerical gentleman from Spain said it would conduce to "la unio dels pobles llatins en altres rahons que en les dels costosos exercits y en les fortificacions de les fronteres." An interesting episode was the reading of a Provençal ode to James the Conqueror by William C. Bonaparte-Wyse, composed at the Manor of St. Johns, Waterford, Ireland—"Lou grand Rèi, lou bon Rèi"—a spirited poem. Here is a stanza :—

Lou bon Rèi, lou grand Rèi
Qu'èro de Catalan lou pastour e lou paire
Legan di belli dono e di muso l'amaire
Qu'èro i reiaume, i rèi
Un nivas e pièi uno estello,
I nemi de la Gléeso un uiau cerulen ;
A milo e milo ami un delicious alen ;
Tour a tour, trou, vouès cantarello !

Very interesting to me was the Rabelais procession. I present for your inspection the commemorative programme, and one of the Montpellier students' caps, called "la toque Rabelais." Each faculty has a distinctive color. This cap belongs neither to Arts, Medicine, Law, or Divinity, but to a Faculty we have not as yet in Canada—"*Les Beaux Arts.*"

ROMAN REMAINS AND SURVIVALS AROUND NIMES.

We had seen the Palais Gallien (Gallienus' palace) at Bordeaux ; strong Roman masonry, not without the thin hard Roman bricks which are still used in many parts. But it was not until we arrived at Nimes that we felt the influence of Imperial Rome yet strong.

Nimes passed under the domination of the Eternal City in 121 B.C., when Fabius Maximus beat the Volces Arcomici at the confluence of the Rhone and the Isère. It thus early adopted their laws, and soon their language. It is not mentioned by Caesar, but Augustus, on his way to subjugate the Cantabrians (of Biscay) established a colony of veterans of the army of Egypt (27 B.C.). This may really be called the founding of Nemausis. I saw in the collections of antiquities there at least two Egyptian bronzes —one an Osiris, the other I could not name—which were very likely lost by the men of this very colony. In a few years it came to have institutions and monuments like those of Rome, and forty years thereafter Strabo speaks of it as a powerful town. To M. Vipsanius Agrippa, Augustus' son-in-law, it owed its aqueduct, its walls, its roads. Caius and Lucius Caesar, sons of Agrippa, presumptive heirs of Augustus, also

favored the town. Tiberius, Titus, Trajan, Hadrian, Antoninus and Diocletian were all pleased to embellish the city, and much of their work can still be seen. It was called the second Rome, and was noted for its rich libraries, its magnificent public and private edifices. The monuments left are so remarkable that I will briefly allude to them :—

First one must mention the grand amphitheatre—on a smaller scale indeed than the Coliseum at Rome, but nevertheless calculated to seat 24,252 spectators. At a recent visit of President Carnot, over 20,000 were thought to be assembled within it—filling the arena, and swarming as they best might over the dilapidated seats.

Misfortune came to this as to the city at large, when Crocus the Vandal took the city in 407. He knocked off the heads of all the sculptured eagles, destroyed the baths, broke the aqueduct, and played havoc generally, until one Marius beat him and had him carried about on exhibition in an iron cage. Then the Visigoths took possession of the region, but the Franks, following on their heels, made it bad for Nimes, for the Goths had to fortify themselves in the Amphitheatre, and were not over solicitous about injuring its remaining beauty. The Moors, too, afterwards held the district, and the people of Septimania were not unfriendly to them, which brought renewed misery, for Charles Martel came thundering down, had the gates of Nimes destroyed by fire, broke down the walls, and tried to burn the Amphitheatre, the traces of the fire being yet plainly visible. During the Crusades Nimes somewhat revived, but thereafter came the wars of the Hungarians, Spaniards, Burgundians Normans, and the English ; the plague ravaged it thirty-three times, and leprosy made it a home. Religious strife was bitter there, and by turns both parties suffered. To day the Huguenots claim to have the upper hand—*le haut du pavé.* If the amphitheatre had not been built of the most enormous stones, fitted to their places without mortar, they would have been removed during all this hurly burly, but still it stands. It owes much to Napoleon I., who, finding that some 2,000 people were living in it, having streets in the arena and dwellings in the noble arches, said, " Clear it out," and it was cleared. Now it is well kept as a national monument—and again there are shows in the great oval, but they are only of trapeze performers or of so-called bull-fighters, on a Sunday.

The next important Roman relic is the well-known *Maison Carrée.* If the arena symbolizes strength, this lovely temple is typical of grace. It seems to be ascertained with reasonable certainty that it was completed in the year 1, as a temple to Caius and Lucius Caesar, previously mentioned. Its vicissitudes have been as striking as those of the amphi-

theatre. It has been in turn a church, a dwelling, a stable, and a museum. Now the houses and sheds which were built against it have been demolished, a goodly space around it cleared, and it can be admired as one of the most exquisitely proportioned buildings in existence. Excavations in the neighborhood have discovered the fact that at one time this architectural jewel was set in a grand surrounding colonnade, but all traces of this noble work have disappeared ; we must rejoice that the *adytum* itself has been left. In the Bodleian Library, at Oxford, are models of the Parthenon, of St. Peter's at Rome, and of this Temple to Caius and Julius—*principibus juventutis.* When you compare them thus, the beauty of the *Maison Carrée* is the better brought out. It is now used as a public museum of antiquities. They have at Nimes the remains of a couple of Roman gateways ; they have in a lovely park, the remains of a Bathing establishment—probably a ladies' bath house, supplied by a beautiful and bounteous spring. This was "restored" but too much altered by Louis XIV.; one can, however, yet trace the plan of the structure, with its retiring and dressing rooms, marble floored and marble covered colonnaded galleries around the baths and runlets. Close to this is a temple to Diana, another exquisite fane, behind which may still be traced the outline of the dwelling of the priestesses of the temple. On the highest neighbouring hill overlooking the city and the broad valley of the Rhone is a huge tower, known as the Tour Magne, the origin, date and purport of which are unknown. Some say it was a Gaulish work, for it seems to have been a round tower, slightly tapering upwards, the masonry built around a core of earth ; the earth may have been filled in as the wall rose, thus dispensing with scaffolding. This earth has now been removed and a central pillar built, round which winds a stair. When I afterwards saw the Tower at Trebia high up on the Cornice road, overlooking Villafranca, and observed the similarity of the two structures, I thought it was not unlikely that this, like that Tower, might have been built to the honor and glory of Augustus, not without an eye to a practical purpose, as an important lookout. A dozen miles or so from Nimes is the famous Pont du Gard, a bridge and aqueduct, built to bring the waters of the Airan across the Gard to the great city. Two tiers of arches of great span are surmounted by a third tier, of less size, over which the stone waterway is carried. The two tiers are 500 and 800 feet long respectively, and 60 feet each in height. The water-trough is 4 by nearly 6, and is a most striking monument.

Every week or so Roman antiquities—coins, lamps, glass bottles and the like—are dug or ploughed up in the country, and I was fortunate in

obtaining a well preserved coin of Faustina, daughter of Antoninus, wife of Marcus Aurelius. What I wish to say is that the thick neck, square shoulders, strong determined features, which seem to have distinguished the Roman soldiery, are still noticeable among the rural population around Nimes. At Nimes, a few years ago, a statue being wanted for a public place, they erected one to Antoninus Pius. At any other place—say at Toronto—a statue to a Roman Emperor would seem an anachronism, and we should be tempted to say, with Hamlet—

> "What may this mean
> That thou, dead corse, again in complete steel
> Revisit'st thus the glimpses of the moon,
> . . . . .
> With thoughts beyond the reaches of our souls."

But that is not the case at Nimes. Antoninus stands there as of right, "in his habit as he lived," and the inscriptions are curious. One in Latin says the statue was decreed by the Senate and people of Nimes (Senatus Populus que Nemauçensis) (you remember the S. P. Q. R.) Only "the Senate and people of Nimes" means the Common Council and citizens —and another inscription in French gives the names—Clarke, Mayor; Dodds, Chairman Carnival Committee; Shaw, Chairman of Board of Works, *et al.** There is also on the pedestal a charming quotation from a recent poet :—

> " . . . . Le Nimois est à moitié Romain
> Sa ville fut aussi la ville aux sept collines.
> Un beau soleil 'y luit sur de grandes ruines
> Et un de ses enfants se nommait Antonin."

> " . . . . Half Roman is the citizen of Nimes,
> Her seven hills, those of Rome itself may seem.
> Bright suns here on Imperial ruins shine,
> And native was the Pious Antonine."

At Arles, not far away, is an amphitheatre as capacious, but not so massive and not so well preserved, as that at Nimes.

The Arlèsiennes, the women of Arles, are also of a distinct race—handsome women with singularly clear, fair complexions and dark hair. I had little time to form distinct impressions, from the one wedding party of them in the distinctly specific local costume I had a glimpse of, but I thought them Greek. Arles was a Greek outpost of Marseilles.

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* These are well-known personages in civic circles at Toronto.

GREEK TYPE AT MARSEILLES; WITH THE HISTORY OF ITS EARLY SETTLEMENT.

Now I was not dreaming of Tyrian, Carthaginian, Greek or Roman when at Marseilles I walked, one summer morning, up the broad Cannabière, one of the "streets of the world," ranking with the Rialto at Venice, the Strand in London, the Avenue de l'Opera in Paris, Broadway in New York, Peter Street in Quebec. But my gaze was suddenly arrested by the girls who were selling flowers, fruit and vegetables—for at Marseilles, though there are public markets, it is the custom to sell such things in the streets also. Such graceful lithe figures, active movements, firm elastic tread! And then such features! When I began to look at the young women who were serving in the shops, or standing in the doorways, the same unmistakeable natural stamp was there. Impossible for one who has seen Greek statues, Greek coins, even the cuts in schoolboys' books, not to be struck by these magnificent profiles. Perhaps I was especially prepared for the revelation because I had recently been comparing Chaucer's description of a handsome girl* with Anacreon's—the northern ideal with the southern—and had sent to the Toronto *Week* my version of Anacreon's ode Εις κουρην, which I may perhaps venture to repeat:

ANACREON TO HIS SWEETHEART.

Ἄγε ζωγράφων ἄριστε

Now, my celebrated painter,
Best of portrait painters, paint her.
Show your skill in graphic art,
Sketch the face of my sweetheart.

Smooth and shining paint her hair,
Black as night. And if you dare
Put the canvas to the trial,
Wash in scent from crystal phial.

Following up this brave beginning
Draw her features, bright and winning.

Round her forehead, ivory clear,
Crimson fillets make appear.
Arch her brows with cunning art:
Black, neither joined nor far apart.

* Chaucer—The Court of Love.

Drooping lashes, long and dark
Clearly on the picture mark.
Then, her glances well to match
Sparks from glowing furnace catch.

Bright as Athene's own her eyes,
Limpid blue like Cythera's skies.
Milk with roses duly mix,
On her cheek its blush to fix.

Ruby lips, love's own delight,
Chin and throat as marble white,
In their curves all Graces hovering,
Charms at every move discovering.

Give her robes of purple glowing,
Hints of gleaming softness shewing—
STOP! Her very self I see
Speak, fair image, speak to me!

Such are the features which to this day you may see in the byways of Marseilles. The people are vivacious, voluble, free in manner as in carriage, active in business, sharp at a bargain, and as for their excitable interest in politics—need I do more than mention the song of that modern Tyrtœus, Rouget de Lille, the Marseillaise, which has had no little to do with the recent revolutions of the world, and owes its name to the fact that the Marseilles troops of militia were the first to take it up? It suited their ardent temperament; they carried it to the army of the Rhine, and as a flame it swept over France, and therefore over Europe. All these are Greek characteristics, and I doubt if there are purer Greeks in Greece than in this great historic town.* Alas! that I must admit that at an age when in our clime matronly beauty is but fairly developed, these Marseilles ladies have increased to anything but a poetic weight. Greek again. For is there not in my Byron a note ungallantly informing me that the Maid of Athens, *Ζωη μου σας αγαπω*, had come to be weighed in avoirdupois? There is one singular survival which I noticed with great delight. The strawberry pickers do not put their luscious berries in bass-wood boxes, as we do, but in *lecythi* of true antique shape, of thin red pottery. They cost perhaps less than our baskets, but though I hoped to shew you one it broke.

Visitors to Marseilles are not allowed to forget its earliest history, for in the fine Musée, on the landings of the grand stairway, are frescoes of the landing of the Phoceans. I have since seeing these refreshed my

* It is clear too that these Greeks had the character always attributed to the lively and artistic Ionian tribe, so distinct from that of the serious, grave, and heavier witted Dorians.

memory with Guizot's history, who says that the early Phœnician settlement was taken over by the Rhodians, whose city Rhodanecia or Rhoda may have given its name to the Rhodanus (the Rhone). They, however, did not keep it, and room was left for Euxenes, a travelling adventurer from Phocea, a Hellenic town of Asia Minor. Nann, the local Gallic chief, coming to meet him on the shore, invited him to festivities connected with the wedding of his daughter Gyptia. This damsel, using a privilege which is said still to obtain in some neighboring regions, carried a cup of wine to Euxenes, to express her preference for him. Of course the Phocean hero married her, receiving with her as a dowry the site of Marseilles and some neighboring cantons. No wonder he called his wife Aristoxena (best of hostesses). While he stayed to build a city, which he called Massilia, he sent his fleet away for a relay of colonists, who came next year, bringing not only the vines and olives of their native land, but also a statue of Diana which they reverently fetched from Ephesus; also a priestess Aristarche, skilled in the necessary rites. This was in 600 before Christ. When, sixty years later, (B. C. 542) Cyrus the Persian reduced the Asiatic Greeks into subjection, the Phoceans left him their empty houses, migrating in their ships, with all their property. A large number went to Massilia; another considerable band tarried in Corsica for a time, then joined their predecessors. These re-inforcements added much to the power of the young state, which had already been conqueror in combats with the Gauls. It grew in trade and influence, and threw off sub-colonies to Monœcus (Monaco), Nicœa (Nice), Agatha (Agde), Antipolis (Antibes), Emporiœ (Ampurias, in Catalonia). Filled with Greek merchants were also the Gallic towns Cabellio (Cavaillon), Avenio (Avignon), Arelate (Arles) and others. Massilia was active, too, in intellectual pursuits; her grammarians revised and annotated Homer's poems; her travellers, Euthymenes and Pytheas, in the latter half of the 4th century B. C., respectively cruised along the west coast of Africa and the coasts of the Black Sea; perhaps even reaching the Baltic. Now I have not been able to find the original of Guizot's pretty story, which seems to me as apocryphal as Virgil's tales about Æneas and Dido.* But there is ample historical evidence of the evacuation of Phocœa and of the Greek colonization of Marseilles. Herodotus, (Clio. chap. 163) gives the particulars of the fall of Phocœa. He recounts that Harpagus, having received the command of the army of Cyrus, sat down to besiege this Ionian city. "Now

* Prof. Maurice Hutton favors me with the following note on this subject:—"According to Aristotle (quoted in Athenaeus XIII., Chap. 36, p. 576) Euxenus marries Petta, and founds, or joins in founding, Marseilles. According to Justin (quoting from Trogus Pompaeus) XLIII., 3, Euxenus marries Cyptis; this appears to be the version to which you refer. The father's name is given as Nannus or Nanus in both versions. Nothing is said by Aristotle of a gift of land for dowry."

these Phocœans" says the father of history, "were the first of the Greeks to use very large ships, and to explore the Adriatic Sea and to visit Etruria, Spain and Tartessus. They did not make these expeditions in mere freighting craft, but with regular galleys of five tier of oars. When they visited Tartessus, they were well received by king Arganthonius, who reigned there for 80 years and died at 120. He thought so highly of them that he first desired them to leave Ionia and take their abode in his country, wherever they might chose a spot. And failing to persuade them to this, when he heard that the Persians were troubling them, he sent them treasure to build their walls, and this in no niggardly way, for the circuit of the walls was not a few stadia, and they were built with great stones well fitted together. Now Harpagus, in taking command, besieged them, but sent to say he would be satisfied if they destroyed one tower and demolished a single dwelling. But the Phocœans, averse to servitude, said that they wished for one day to take counsel together, and would then give him an answer; but that they might freely deliberate, he was to march his army from the walls * * * and when this was done, the Phocœans, bringing in their quinquiremes, made their wives and children embark, put in all their belongings, the ornaments of the temples even to the brasses or marbles which had inscriptions; they then went on board themselves and sailed away for Chios; so the Persians obtained possession of Phocœa, deserted by its people.

As the Chians would not sell them the Œnusian islands, the Phocœans soon left for Cyrnus (Corsica), where, twenty years before, they had founded a city named Alalia—for by this time Arganthonius was dead. * * * They had been there five years when the Etrurians and the Carthaginians attacked them, and a battle took place, with 60 ships a side, in the waters around Sardinia, in which the Phocœans gained a sort of Cadmæan victory, losing 40 ships and having the other 20 shattered, so, returning to Alalia, they embarked their families with what household goods they could, and went to Rhegium * * * afterwards to Velia.

Herodotus, you see, does not mention Marseilles, but Thucydides does (I. 13) and this battle must have been subsequent to the one he speaks of, saying "The Phocœans who inhabited Massilia, beat the Carthaginians in a sea-fight." *Isocrates* (Archid. t. II. p. 68) says: "The Phocœans fleeing from the despotism of the Greek King, leaving Asia, moved to Massilia." We can also quote *Aristotle*: "The Ionians of Phocœa, needing an emporium for trade, founded Massilia." *Ammianus Marcellus*, XV. 23, says: "The people of Phocœa, in Asia Minor, to avoid the attack of Harpagus, the lieutenant of Cyrus the King, set sail for Italy; one part settling at Velia in Lucania, another founding Massilia, in

the Viennese." *Seneca* (confounding Phocœa with Phocis) (ad Helv. VIII. 1.) says: "Leaving Phocis the Greeks who now inhabit Massilia, first settled in Corsica." In the Punic war time, Massilia was always friendly to Rome, and to her people was granted a place amongst the Senators, at the festivals of the Republic. In the Civil wars, it declared for Pompey; Cæsar took it, and established a rival to it at Forum Julii (Fréjus). Its Greek speech, however, does not seem to have survived long; it was the Romans' policy that all subject states should use the Latin tongue, and none dared question Claudius' remark—"He is no Roman citizen who is ignorant of the language of Rome."

I was told that near the water, at Marseilles, there now begins to be a little infusion of Arab blood, which gives a warmth of umber, or perhaps I should say olive, to the otherwise beautifully fair skin. In the newer parts of the great and growing city one sees the more common-place French type of recent arrivals from other parts of France. I cannot think, however, that the fine Greek strain which has lasted 2,500 years, so purely, will rapidly be absorbed and lost; it must rather continue to imprint its strong heredity on the people of Marseilles for centuries to come.

THE CELT IN WALES.

I began with the Celt in Brittany. I will end with the Celt in South Wales.

It is the fashion to pronounce this Kelt, as we hear Cicero called Kikero, but I again protest against the mannerism. Nothing could be more useful to philosophy and interesting to all students of languages and history than to fix upon the phonetic equivalents of the consonants and vowels of ancient Greek and Latin, nor do I think it impossible, but that serious study which it deserves has not yet been given to the subject, which must be attacked by those who have first learned the common speech of the still isolated populations of France, Italy, Greece, and the regions around the Carpathians and the Balkans, where traces of the ancient sounds may reasonably be supposed to linger. The C if not pronounced as in modern Italian, may have had more the value of Ts, or perhaps of a guttural-aspirate, or aspirated-guttural.

I do not feel qualified to enter into the controversy as to how far the Southern Welsh or South-western Irish are of Iberian or Basque stock; how indeed they are correlated with the Celt-Iberians or Portuguese. I shall deal with them as Celts proper, of that wonderful old race, or agglomeration of prehistoric races, which has left its traces in many parts of Europe, and is making its last stand for individuality in the British Isles.

I found, on visiting Swansea, that a Gorsedd was in progress, and was much interested in the ceremonies. An Eisteddfod most people know to be a meeting at which Welsh poetry and Welsh music are enthusiastically listened to and admired. It is not so generally known that exactly one year before the opening of an Eisteddfod, a Gorsedd or meeting of the bards must be held to proclaim it in the proposed place of meeting.

The Swansea Gorsedd was held in an open space (such is the rule), where was a fence (made of Canadian pine scantling), within which were twelve unhewn stones as a circle. There were three other and larger stones within the circle, at the west side. A " Druid " was perched upon each of the twelve stones, and a "bard" upon the three others. There was a harp, and a poet sang to its accompaniment some original verses, in Welsh, which were strange in rhythm and pleasing in melody. The Druids unsheathed a sword in a peculiar fashion, and three times asked if there was peace. The surrounding people said there was peace. Then the Eisteddfod was proclaimed. When any thing was said by the speaker (in Welsh) which pleased the assemblage, they shouted " cleuch, cleuch," meaning " hear, hear." And when the sword was sheathed and the ceremony was at an end, a good clergyman spoke for a long time in Welsh, and in English. The Welsh speeches and the verses were translated for me by a local scholar, and I found in the whole ceremony a resemblance to Indian pow-wows I have seen, especially one near Rat Portage. There appears in both to be some reference to the sun ; the Druids enter the circle from the east ; face the east when speaking ; the Indians sit in a circle too, their music (if their drum-beating can be called by that name) in the inside too ; their old men dancing round *with* the sun, etc., etc. The good clergyman patronized the whole proceedings in a friendly way, as I have seen our Indian agents patronize a pow-wow. I cannot, however, think there is in the Gorsedd, as I saw it, any real survival of a true Druidic observance, while as for the music and rhyming, it is on a line with cottage flower shows and Highland athletic meetings—a pleasant, harmless diversion, not without its uses. The facts show Welsh to be a dying language in Wales as Breton is in the corresponding peninsula in France, though it may last another hundred years or so in common use, in remote districts. The nomenclature of places will continue perhaps for thousands to betray Celtic origin, as it does in Europe. Nor will the character of the people quickly change. Short of stature, thick set in build, dogged in temperament, somewhat choleric, rebellious by nature, as deeply addicted to strong drink as semi-barbarous races, hospitable to

the extreme, tenacious of their soil, customs, habits, they are a very important constituent part of the British nation, and so they will remain.

From the whole of the observations and studies of which the foregoing remarks are a brief *resumé* we may gather part proofs of how long inherited characteristics endure, even under the most adverse circumstances; that language and religion change, but that habits, idioms, and complexions* endure from generation to generation, almost forever.

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* A singular and interesting investigation has recently been made in France under the auspices of the French Association for the Advance ment of Science. Statistics have been collected in each department, of the color of the hair and eyes of the populations, and are published with graphical maps in the Proceedings of the 18th Session. If a line be drawn from Savoy to the extremity of Finisterre, the country north-east is that of the blond peoples, the rest is that of the darker races. One is not surprised to find the dark haired tribes occupying almost exclusively the Mediterranean littoral and the slopes of the Pyrenees, nor to find the greatest proportion of blond races along the Channel ; but there are most singular irregularities and important specia, features. For instance, Morbihan, the most Breton part of Brittany, is one of the most blond of the departments, while the country on both sides of the Lower Loire is one of the darkest. A flood of light may, by this investigation of Dr. Topinaid's, of Paris, be let in upon anthropological subjects ; historical problems be resolved, and possibly the influence of climate and soil considered in a new way. What is the Celtic type of hair and eyes? What are (if any) the permanent characters of other races? Is it true that the Canadian population is losing the blue eye and acquiring n increased proportion of brown eyes ?

PEACH YELLOWS.

By W. R. Shaw, M.D.

[*From the Biological Laboratory of the University of Toronto.*]

(*Read 21st November, 1891.*)

Yellows is an infectious disease which occurs in almonds, nectarines, apricots and peaches, in which it is characterized by particular lesions in the fruit, foliage, development, and general appearance of the affected tree.

The duration of the disease is long, generally lasting over a period of four years, and the name is derived from the yellowish appearance which a tree in foliage assumes when so affected.

The work having been done wholly in connection with peach trees, our remarks are accordingly confined to the nature of the disease in that particular class.

It would be as well to style this subject not "peach yellows," but "yellows in peaches," as you will see by the above that it is not peculiar to that one particular fruit.

These investigations were begun in the early part of the past summer (1891) to find out if a cause could be discovered for the disease, and this work has been pursued in the ordinary methods adopted for a bacteriological investigation. It is of importance, both scientifically and from a domestic point of view, and if by any means some light can be thrown on the disease so that proper steps may be taken to stop its ravages, then to my mind an important work has been done.

It is to be regretted that the subject has not had more time for its further consideration, but it being desirous to bring it as soon as possible before the Canadian Institute in order that they may use their influence for the proper means being adopted for the stamping out of the trouble, I must present this as the apology for the present paper being incomplete and simply a "preliminary report of the work."

Before proceeding, a short résumé of the history of this disease since its first authentic description on this continent, would not be amiss, and I am much indebted to the report of Mr. E. F. Smith, of the Depart-

ment of Agriculture at Washington, who has written an exhaustive history on this subject.

The disease first made its appearance in Pennsylvania in 1791 or nearly about that period, whence it has spread in all directions. The next place it was noticed was in New Jersey, in 1806, and a second epidemic affected the orchards of that State in 1846, doing most extensive damage to the trees. It is remarked in New York State in 1814, and in 1833 "yellows" is given out as one of the chief causes of the decay of the peach cultivation in that State.

Following north, Connecticut was visited in 1814-15, and one cultivator in that State fully recognizes the infectious nature of the disease, for in 1845 he writes: "When one tree is infected other trees standing near would be unless the infected tree was immediately removed, in which case the healthy trees would generally be preserved."

Massachusetts seems to have escaped until much later, and in 1882 it was said that yellows was not in existence in that State.

Again starting from Pennsylvania, its spread in a north-west direction has been carefully traced. It appeared in Ohio in 1849, and in July of 1878 it is described as being in the Niagara County of N. Y. State. It is but a short distance from there to our own Niagara peninsula, and in Ontario in 1878 a Mr. A. M. Smith, of Drummondville, writes an article in the *Canadian Horticulturist* under the title of "A Word of Warning to Peach-Growers in Ontario," in which he remarks that "Perhaps it is not generally known, but it is, nevertheless, a fact, that the disease so destructive to peach orchards, called the yellows, has made its appearance in our midst. Quite a number of orchards on the frontier, particularly in the neighborhood of Drummondville and Stamford, have had affected trees in them the last season, and some in the great peach-growing section of Grimsby." In the autumn of the same year Mr. Smith's report was confirmed by Mr. L. Wolverton, and he draws up a resolution to the effect that "when anyone noticed the first indications of the disease, the trees so affected should at once be removed from the orchard and destroyed."

By the year 1880 the disease had become prevalent throughout the whole of the Niagara district, and thus we have it fairly established in our midst.

In 1881 the Legislative Assembly passed an Act to prevent its further spread, which was amended in 1884 and the American work to which I referred in the beginning of this paper, comments on it as follows:—

"That it is practically worthless for the following reasons:

1st. A petition of 50 ratepayers is necessary to secure the appointment of an inspector, if council is not disposed to appoint one without.

2nd. The inspector can act only on a written complaint.

3rd. The fine is trifling both for neglect to destroy trees and for selling fruit.

4th. No provision is made for the immediate and complete destruction of trees and fruit in case of neglect or refusal on part of the owner to comply with the law."

And now to continue the history of the spread and destruction by yellows. It spread throughout Michigan, and that State from being the foremost one in the world for peach culture has fallen of late years to a much lower place, and to cite figures—the number of acres in peach orchards in 1874 was 6000, making about 654,000 trees, while in 1884 the numbers had fallen respectively to only 503 and 54,827.

The same tale is reproduced in each State where the orchards have become infected with the disease—a few States are said to be exempt, but some uncertainty prevails as to the truth of the assertion.

Let us now pass on to the *symptoms*, better styled *signs*.

Fruit.—One of the first signs noticed in the early part of the century and before the disease had been definitely described and located, was the fact that some fruit ripened prematurely, and it was soon found that this was one of the first or almost premonitory signs of the affection. This early ripening is irregular in length of time, varying from a few days to even six weeks, but the average is generally a ripening two or three weeks in advance of the proper time. Along with this sign may be mentioned the characteristic changes in the coloring of the fruit. As a rule there is more color than usual, but along with that is the "coarsely blotched" appearance with red or purple spots, these spots being irregular in size and striking in appearance, giving to the fruit a mottled or speckled look. They are, as a rule, well marked, being much darker than the background. Sometimes they coalesce, and the fruit then presents the appearance of a dark red or crimson color. [I might note here that the sure diagnosis should not be made until the fruit is opened, as we found in one variety in an orchard the small dots on the surface but not at all in the substance of the peach.] In peaches which are diseased these spots are not confined to the covering, but on cutting into the fruit

at right angles to the surface, red streaks are seen which can sometimes be traced from the pit to the surface and corresponding with the "surface marking" above described: a cross section of the fruit shows these lines as red dots in the yellow substance of the peach, which is pathognomonic. The reddish or crimson color around the pit is also increased above that of normal healthy fruit.

Taste.—The taste is sometimes normal, sometimes the fruit is quite insipid, not infrequently slightly bitter. In some of the samples tasted this year the flavor seemed to strike the back of the palate after a few seconds and had a "tannic character" to it, lasting quite a time after the peach had been tasted.

Decay.—This occurs more rapidly than in normal fruit.

As a rule the above are the signs which are first discoverable in a tree which is affected. The following season not only will the peach but also the foliage and smaller branches show signs of the disease.

Shoots.—The young shoots develop and sometimes fill the whole interior of the tree top. This growth consists of small, unhealthy shoots which are frequently much branched; the leaves are small, narrow and sharp, and are clustered a good deal and the whole combination gives the tree quite a bunchy appearance at the top. According to some of our Canadian growers, these characteristic branches are seen first on the large primary branches of the tree and are found growing up as thin delicate shoots with the same small leaves, and all with a yellowish tinge about them. It should have been remarked above that the leaves are yellowish in color, and hence along with the bunchy appearance is also the yellowish colour of the tree from which the name of the disease is derived. The leaves are very justly compared to those of a willow tree, and average not more than two or three inches long by one-quarter or one-third inch wide. The shoots are much like willow twigs in form, but are not so resilient.

These small, ill-developed twigs, along with the not too markedly yellowish tinge of the tree, and its bushy appearance, quite diagnose the affection in the tree itself.

Frequently only one limb is affected that year, but next season the disease will be noticed to be general throughout the whole tree.

The following year the tree has all the above signs in a more marked degree, frequently having no fruit on it, and with death of some of the limbs. The foliage is dwarfed, yellowish or reddish-brown, and

more or less curled or in-rolled, over the whole of the tree, and the tree at once presents a striking appearance when compared to the deep green of a healthy one. The curling of the leaves is generally due to insects, and often there are brown or red spots on the foliage, which are caused by the fungus Cersospera, which finds a more favorable nidus for growth on diseased leaves.

The diseased trees seldom live longer than four years, and at that period of the affection they have scant foliage, are very brittle and stiff, and altogether present a strikingly unhealthy appearance. They rarely produce fruit in the late stages, and have many dead limbs.

Symptoms in man from eating the fruit.—We will now pass on to the symptoms frequently produced in man and will then take up the diagnosis.

Violent diarrhœa, slight fever, much abdominal pain and discomfort of three or four days' duration form the symptoms which mark the eating of the fruit. One physician informed us of a whole family having been so affected through eating diseased peaches, and he attributed many other attacks of a similar nature to a like source, although the evidence was not so direct.

Diagnosis.—The disease must be discriminated from several other conditions which produce somewhat similar changes in the appearance of the trees, but the fruit is diagnostic, in that the changes only appear in this one affection.

The borer.—The larvæ of the "Aegina Exitiosa." A careful examination of the tree will reveal the cause of the unhealthy appearance. Then in this as above stated the fruit is not affected, and again the leaves are said to fall off in August when the tree is vigorously shaken, which is not so with those affected with yellows.

Root Aphis.—This attacks the roots of the peach tree, and consequently the nourishment is much impaired. It is mostly found in trees planted in sandy ground. The trees are generally stunted in their third or fourth year. Again the same remark applies to the peculiar alteration of the fruit, which will never be seen when the tree is destroyed by the Aphis.

Peach Nematode—Does not occur in this country, and hence can be passed over.

Starvation.—Trees planted in pure sand and peat produce a feeble growth. Cultivation will alter this condition and also its method of attacking groups and not isolated trees will help in the diagnosis.

Wet subsoil—May also produce unhealthy trees, but in this as in all the above conditions the fruit will diagnose the condition.

Cause.—This portion of the work will perhaps be the most interesting, for we are aware that until the cause of a disease is discovered, and the affection placed in its proper category, proper methods of dealing with the disease cannot be instituted. It has been my object since beginning these investigations to find, if possible, a probable cause of yellows in the form of a micro-organism and to isolate it from the diseased trees. Guided by the work of Prof. Burrill, of Champaign, Ill., who has isolated a bacillus from the affected trees, I proceeded in the same lines adopted by him.

To be sure there will be many who still maintain that soil exhaustion, etc., etc, will produce the disease, but from observations of others and the few which I have made myself, I have come to the conclusion that it is a disease which is due to a bacillus and undoubtedly contagious or infectious in character. Soil exhaustion may play a part, in that it will leave a tree more liable to infection than a perfectly healthy one, but aside from that I am of the opinion that it constitutes no part whatever in the disease.

There seems much variance of opinion as to whether a tree planted in the place of the one which has been removed will contract the disease, and it cannot be stated with any definiteness which is the correct opinion. More careful inquiry will have to be made before it can be answered.

Then again, considering that the affected tree does not generally infect those in its vicinity, but ones quite removed from it, spreading in this irregular manner throughout the whole orchard, and in combination with this the fact of the disease first showing itself in the fruit, it appears to me a likely hypothesis that the flower of a diseased tree contains the germ in an active state, and that it is conveyed thence to other trees by bees or the wind, thus also explaining how it spreads in the above described erratic manner. This to me seems the most feasible proposition for the spread of the disease, but of this we shall hope to be able to speak with more certainty at some future time.

I shall now proceed to detail the results of the work. During the past summer a few trips were made to Niagara-on-the-Lake, and with ordinary bacteriological precautions, inoculations were made into tubes of agar-agar from the cambium layer of the bark. Many of these tubes developed nothing, but in others some results were obtained, and so far I have found three distinctive forms present in the diseased trees, which forms are bacilli, and will be respectively styled A. B. and C.

Bacillus A — Found in 21 per cent. (about) of the affected trees: Under the microscope—small bacillus, even staining, frequently in pairs, rounded ends, and very often curved. Size, 5 to $6\mu \times 9\mu$. Stains well with Mythyl. Blue (Alk.), Fuchsin (carbolic), and by Gram's method.

Hanging Drop.—Very active.

Culture.—Appeared on surface of agar-agar two days after inoculation as a small, white, thin, moist colony.

Agar-agar plate.—Small white col. which under low power is yellowish white, irregularly round colony with irregular wavy edge and dark central spot, flat and finely granular; slightly dome shaped thinning away at the edge to transparency.

Agar-agar stab.—White healthy growth spreading well on the surface of agar-agar as smooth, white, glistening colony, not moist. It grows well along the needle track, not tapering at all, but same thickness throughout.

Gelatine plate.—Small, round, white col. which is about ½ m.m. in diameter at the end of five days. Under low power of microscope the surface colonies look like perfectly round, smooth, yellowish white colonies, flat surface, semi-transparent, edges thin and very smooth. (The very thin colonies show fine granulations.) Some colonies seem to be made up of rings of different depths of color; no liquefaction at end of three days but commencing on the fifth and proceeding rapidly.

Gelatine stab.—Grows rapidly and well in gelatine. No liquefaction at end of six days. Appears as yellowish white, smooth, moist looking colony, spreading on the surface with an irregular outline; grows slightly along the track of the needle as a very finely granular growth, tapering from the surface and not spreading in the gelatine. After 15 days liquefaction commencing and proceeding in a champagne-glass form. The surface is covered with the tenacious, slimy colony and the liquefied gelatine is cloudy with fine granules with a precipitate of the same nature. Rest of the medium clear. After about 20 days the liquefaction has extended over the whole surface of gelatine, and it is gradually all becoming liquefied with the above characters continued.

Bouillon.—Produces fine white growth on surface which sinks on a gentle shaking of the tube. The whole of the medium becomes misty in appearance, due to fine white granules suspended throughout the Bouillon.

Potato.—Yellowish white, elevated, convex growth with smooth, dry surface, extending very slightly beyond the line of inoculation. Surface

is irregularly marked with slight depressions which cross it at right angles to the long diameter of the growth. In many places the growth looks like drops of yellowish wax on the potato. The color of the potato does not seem to be altered by the growth.

Temperature.—Grows at the temperature of the room, and it seems to be very susceptible to heat, the warmth necessary for keeping the agar-agar tubes fluid seemingly destroying it.

Spore formation.—

Color.—Not any, except slight tinge of yellow in the potato growth.

Action on gelatine.—Grows fairly rapidly and is a slow liquefier throughout—10 cc. of gelatine not being all liquefied in 33 days.

Bacillus B occurred only in 7 per cent. of the tubes. Under the microscope it appears as a very large bacillus, rounded ends and showing tendency to go in pairs and chains of three or four. Very marked spore formation. Size, 1·8μ × 9·0μ. Stains well with all the stains and with Gram's, Carbolic Fuchsin, etc.

Hanging drop.—Motionless.

Culture.—Appeared in the original tube as white growth spreading much on surface and not elevated.

Agar-agar plate.—Oval, yellowish white, large colony. Under low power—oval, blackish, thick colony, very granular, dome shaped, edges very rough and the colony irregular in outline.

Agar-agar stab.—Rapid growth, spreads much on the surface as slightly elevated, smooth, glistening, white colony with somewhat irregular outline. Grows well in the substance of the agar-agar along the track of the needle, but tapering away from the surface. After three weeks the growth becomes yellowish tinted.

Gelatine plate.—After three days, the deep colonies appear as small, round, white dots and those on the surface as irregularly round, white, and spreading to about 1 m.m. in diameter. Under low power the surface colonies appear as very irregularly round, yellowish brown, mottled, flat, opaque colonies, slightly thicker in the centre, with very irregularly indented outline, the projections not being sharp but all rounded at points, and it is seen that this is due to the fact that the colony is made up of a mass of fine intertwining threads and these do not project singly but curve around and give the consequent appearance to the projections. The colony is very suggestive of the "caput medusæ." The deep colonies are small round, opaque, flat growths with fine barb-

like projections from the edge. After five days liquefaction first beginning, being shown by a depressed zone of clear gelatine.

Gelatine stab.—An exceedingly slow liquefying growth, and only liquefies around the needle puncture, at the entrance to gelatine, after 15 days. Grows very slowly in the gelatine along the needle track as a yellowish white, finely granular, tapering growth, not spreading in the substance of the gelatine. It spreads on the surface slightly and appears as a yellowish white, smooth, slightly elevated, moist looking colony with irregular outline. The liquefaction proceeds very slowly and in the same manner as Bacillus A (*i.e.*, in champagne-glass form), the surface of the fluidified gelatine being covered by the original surface growth and the liquefied gelatine opaque from finely suspended white granules There is a yellowish while granular precipitate at the bottom of the liquefied gelatine. Rest of the medium is quite clear and solid. After a time the surface colony subsides, and the liquefaction has extended to margins of the gelatine.

Bouillon—Does not make it cloudy, but grows up the side of the tube from the bottom, appearing as very finely granular. No growth on the surface, but slight precipitate.

Potato.—Rapid growth, yellowish, abundant, spreading over the surface of the potato, slightly elevated, edges smooth, but irregular contour, surface moist, glistening and smooth. After two weeks the growth becomes markedly yellow and is thrown into numerous folds.

Temperature.—Grows at ordinary room temperature ; not susceptible to heat as Bacillus A.

Spore formation.—Very marked ; sometimes three or four large, oval spores seen lying irregularly within a bacillus.

Color.—Yellowish tinge to growth on both agar-agar and gelatine, and a marked yellow growth on potato.

Action on gelatine.—Grows slowly in gelatine, and is a slow liquefier.

Bacillus C occurs also in 7 per cent. of the tubes. Under the microscope it appears as a long, thick bacillus with square ends and corners rounded off. Spores noticed—occurs much in pairs and long chains. Size, ·9 to 1·0 μ × 2·7 to 3·6 μ.

Hanging drop.—Slight movement.

Culture.—In original tube appeared as a thin, white growth, spread over the lower portion of the agar-agar.

Agar-agar plate.—White, oval, fairly large colony. Under low power,

dirty whitish yellow, granular, thick, irregularly oval colony with indented edges. Dome shaped.

Agar-agar stab.—Very slow growth along the track of the needle when it appears as a well marked, white, rough-edged growth, same thickness along whole length of puncture. Does not grow on the surface until after a week, when it appears as very irregular, slightly elevated, thin, whitish, smooth surfaced growth, and not spreading but very little on the surface of the agar-agar.

Gelatine plate.—Colonies develop slowly and appear after five or six days. Those in the depth are small, round and white. Superficial ones are thin, white and more spreading. After six days a small depression of commencing liquefaction seen which then continues quite rapidly. Under low power the superficial ones appear as flat, slightly darker in centre, yellowish colonies with very irregular outline, and the whole growth seen to consist of fine threads, twisted in all directions and projecting into the gelatine and giving the colony a hairy appearance. The deep colonies are dark brownish yellow with opaque centre being slightly thinner at margin. Some small projecting fibrillae, which do not seem to extend into liquefying zone.

Gelatine stab.—Very slow growth and still slower liquefaction. At first grows only in the depth of the tube, and not on the surface at all. It appears as a finely granular white growth, from which fine filaments extend into the gelatine a short distance from the needle track. These filaments continue to spread and increase in size, and become larger at the outermost ends. They also increase in length as they approach the surface, and give one the idea of a small balsam tree inverted. The central part which was the original needle track has also increased in size and is seen to be composed of fine granules which seem to be suspended throughout that portion of the gelatine forming the main stem of the tree, as it were, and also tapering in the depth. After one month's growth the gelatine was seen to be dipping as if drawn in towards the stem portion of the growth. To look down on the growth at this stage it has the appearance of a central, round, finely granular zone, which is well defined, and spreading out from it making a complete circle of rays, are the filaments above described. This dipping gradually progresses until the growth apparently reaches the surface, although it does not spread out thereon, and when that condition is reached liquefaction commences and extends down through the heart of the growth or along the old original line of puncture. This is seen to be full of fine granules as above, only some have settled at the bottom of the liquefaction, making a slight precipitate. Thirty-six days after inoculation all

the gelatine involved in the colony has become liquid, forming a funnel-shaped liquefaction in which fine particles are suspended, and some slight collection of these at the bottom of the funnel. Rest of the gelatine remains clear. Gradually the whole tube becomes involved, and at the end of 40 days all the gelatine is liquefied. It is cloudy with fine granules, and a precipitate of same nature.

Bouillon.—Grows at first as a simple haziness throughout the medium, but later a strong, tenacious whitish growth occurs on the surface, which is broken up by much shaking, and partially sinks.

Potato.—After four days whitish, thin, flat growth, inclined to a slight tinge of pink. Surface smooth but dry, and not glistening. Grows slowly. After two weeks it has gradually become brownish and apparently granular, but which, on close examination, shows it to be very finely wrinkled. Potato substance turns dark brown. Edges of colony are smooth and glistening, and the whole surface glistening.

Temperature.—Grows at ordinary temperature.

Spore formation.—Some spores seen, being generally two to each bacillus, round, clear and oval, and not placed in any particular part of Bacillus.

Color.—White growth except on potato, where it becomes brownish after some time.

Gelatine.—Exceedingly slow liquefier, and growth is also very slow.

It therefore remains to be proved by inoculation experiments into the trees, and contamination of the flowers and of the soil, which one of the three forms is the cause of yellows, or if each one will produce a diseased condition of the trees so experimented with, and I hope at some future date to be able to lay before the Canadian Institute the results of such investigations.

Granted that the disease be due to a specific organism, then it behooves this Institute to instigate a movement for a government power to be granted to properly qualified persons to adopt means for the destruction of affected trees, and the isolation in some manner of the diseased orchards. And if laws stringent enough be passed, it is in my opinion possible to stop the spread of a disease, which, if not soon controlled, will remove from the Niagara peninsula a most profitable industry.

Again, the appointments of inspectors should be so managed that competent men should receive them and persons who will not have too much to inspect, and hence imperfectly perform their duties, and also the remuneration should be sufficient to make it worth their while to

accept a post with which more or less disagreeableness is necessarily associated.

I think to all thinking men the necessity will appear for the adoption of some such measures ; for no more right has a man to keep standing in his orchard a diseased tree which is apt to contaminate and destroy his neighbor's trees, than he would be justified in allowing infectiously diseased animals the liberty to roam the roads and fields.

Treatment.—Many things have been tried for the allaying of the disease, but as yet no chemical substance has been found to cause an alleviation of the affection.

To prevent its spread, the immediate destruction of the trees is the first thing necessary, and now that we have the disease so much with us, care in the cleaning and disinfecting of the pruning knives after each tree has been attended to, would perhaps further stop the disease, as the tree may be affected before being apparent to the eye. For such purposes I should recommend two sets of knives, and while working on one tree with one set, let the other be lying in 1 in 40 solution of carbolic acid, which any druggist can make up.

As to whether any remedy can be found for the diseased trees, it cannot be replied to yet, and with the great and grand advancements which bacteriology has made of late in the treatment of disease, both in man and animal, I would not be justified in hazarding any opinion, but do hope that some method may yet be discovered, which will save the trees, although at present I am very dubious. That we can do much in stopping the progress of the disease by the total destruction of the diseased trees cannot be doubted, and let us hope that other results may follow.

Lastly, I am sure that Dr. A. B. Macallum unites with me (as he went with me on each excursion to Niagara) in expressing sincerest thanks to the gentlemen who entertained us so very kindly, placed their trees and orchards at our disposal, and were so kind in coming forward and helping us in every way possible. I myself thank Dr. Macallum for his most valuable assistance on each occasion, and it was through his suggestions that the above work was undertaken.

STUDIES ON THE BLOOD OF AMPHIBIA.

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(Read 17th January, 1891.)

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I. The Origin of Hæmoglobin.*

In the following pages are given the results of studies commenced five years ago and continued with short intermissions till last summer. The length of time taken up in this work was necessarily great because of the lack of previous studies in the same line and because of the want of definite and exact knowledge on the subject of the micro-chemical reactions of hæmoglobin. The difficulty of detecting, by chemical or microscopical methods, any antecedents of hæmoglobin appeared so formidable that, at one time early in the work, I was on the point of abandoning the line of investigation altogether.

I have used for this investigation our Lake Lizard, *Necturus lateralis*, and the larvæ of *Amblystoma punctatum* which are readily obtainable in large numbers in the immediate neighborhood of Toronto in April and May. The advantages which the tissues and structures in the *Necturus* present for cytological work far outweigh those which a comparative study of the blood in a larger number of Amphibian forms would have and there is, therefore, a justification for narrowing the investigation to the two named forms.

* The subject matter of this paper was included in a thesis presented for the degree of Doctor of Philosophy in the Johns Hopkins University, in April, 1888.

A. METHODS OF STUDY.

At the outset of an investigation like this, one has to answer the question: How far can we rely on the different effects in staining produced by a dye in determining the dissimilarity in composition of the objects stained? We can illustrate the question by a case in point: safranin stains the nuclei of the red blood cells of *Necturus* orange-red when they are fixed in a certain way, while the nuclei of ordinary cells under the same conditions take a red color. Does this indicate that the substance in the nuclei of the red corpuscles which is stained orange-red is different in its chemical composition from that in ordinary nuclei? An affirmative and a negative answer are equally consistent with what we know as yet of the relation between staining reagent and object stained. It is quite possible to imagine the molecules of the staining reagent in the object stained so placed relatively to the molecules of the latter that though no chemical union results, certain kinds of the light rays become absorbed in their passage through the object. It is further possible to conceive that variation of the distance of the molecules from each other in the object stained may result in a variation of the rays transmitted. Staining is in this sense a result of a physical condition, and as such many consider it. It is easy also to understand that if the molecules of one stained object should be different in structure from those of another, the interarrangement of these with those of the same staining reagent might affect the light transmitted in each of the two cases differently. In such the difference in color would depend on a difference in chemical composition while the stain in itself would be referable to a physical condition. In addition to these three possible modes in the production of staining reactions there are two others, viz., the action of the stained material in bringing about a change in the composition of the staining reagent and the definite chemical combination of the staining and stained material. The action of the stained object on the staining reagent is illustrated by the effect produced by the chromatin of the hæmatoblasts in the *Amblystoma* larvæ on alum-hæmatoxylin, the usual color given by the latter reagent to ordinary nuclear constituents being there turned to a slate tint. That chemical combination does occur in the case of some reagents is shown by Unna's experiments with several aniline dyes.*

There being, thus, probably several ways by which a stain in an object could be effected, it is manifestly impossible to prove in regard to any particular dye, whether, when it stains a series of objects, the same resulting colors in the latter are produced by the same or different

*Arch. für Mikr. Anat., Bd. XXX. p. 38.

interaction, physical or chemical, of dye and object. It is of course not even probable that the chromatin elements of all cells are chemically the same except in the main outlines of their structural formulæ, yet alum-hæmatoxylin or alum-cochineal gives usually the same color reaction in all. Here the effect is the same but the interaction may or may not be the same in all cases. The subject belongs to borderland between physics and chemistry and we can conceive that the interaction may lie on one side or the other of any arbitrary line drawn to separate the two domains without resulting in any visible difference in color. If different colors should result when chromatin elements, for example, are stained by a dye, then it may be safely inferred that the groups of atoms in the variously stained elements are differently related to the groups of atoms in the staining reagent. It might be suspected in such a case that the difference in stain might depend on a difference in chemical composition and this suspicion would become certainty, if a second dye were found to act in a similar way towards the same chromatin elements.

The difficulties which surround the solution of questions of this sort are very numerous but they are multiplied when one multiplies the methods of hardening or fixing tissues. These methods greatly vary the effects of a single staining reagent on cellular structures. On this account no conclusion of any great value has been drawn as to chemical nature of any cellular substance from the employment of staining reagents alone. On the other hand the employment in cytological research of chemical reagents on objects under the microscope has not been, even to a limited extent, successful.

I have put forward all the difficulties which a research like this presents and they have all through this work been before my mind. I have resorted to the processes of staining, because the question of the origin of hæmoglobin is an all important one and because I can see no other means of settling it. It may be said that the means are insufficient. I can only say in answer that I have tried to do the best with them and the conclusions given in this paper are drawn from the results obtained by the employment not of a few but of a very large number of methods of hardening and staining. It is only by the employment of various staining reagents that one can avoid the errors resulting from an adherence to one or to a few microscopical methods and at the same time reach, usually, at least, measureably certain conclusions.

My first labors in this investigation were directed to finding a reagent which would show the presence not only of hæmoglobin, but of its

antecedent if such existed. I need hardly go over the list of wearisome experiments which I made for this purpose. Many, but not all, of these were resultless. Of the dyes at my disposal belonging to the aromatic group of organic compounds, Eosin is the only one which I found useful. As will be shown below it reacts with hæmoglobin and, in conjunction with alum-hæmatoxylin or alum-cochineal, it is a reagent for the antecedent of the pigment. Taken of course alone, without employing any other reagent for control purposes, it gives results far from satisfactory and it is also very misleading. Another reagent, the employment of which has been of great value to me, is the staining fluid of Shakespeare and Norris,* and which I shall name throughout this paper, for the sake of brevity, the Indigo-carmine Mixture or Fluid.

This fluid is made according to a formula which I have modified from that given by Bayerl, and consists of a mixture of equal volumes of the following solutions :—

A—Carmine, 2 grms ; Borax, 8 grms ; Distilled Water, 100 c.c.
B.—Sulphindigotate of Soda (Indigo-carmine), 8 grams ; Borax, 8 grms ; Distilled Water, 100 c.c.

In preparing each of these solutions, the borax is ground up in a mortar with the dye, the water poured on, and the whole allowed to stand for from five to seven hours before filtering. Owing to the fact that much of the Indigo-carmine in the market is impure, and consequently alters its composition in solution in a couple of weeks, it is not advisable to prepare more than 25—50 cc. of solution B at a time. I have obtained quantities of the reagent which retained in solution for three months its normal staining properties. As A, when kept for a year or more, readily shows undiminished staining power, a larger quantity may be prepared as "stock" solution.

The section to be stained is left in the fluid for fifteen minutes, then plunged in a saturated solution of oxalic acid for ten minutes, washed in distilled water, dehydrated with absolute alcohol, cleared in pure xylol, and mounted in benzol balsam. Preparations made in this way two years ago still retain undiminished their original stain. When I first employed the fluid, four years ago, I used clove-oil for clearing, and found that my preparations faded, or contained a dirty precipitate after three or four weeks. The removal of the clove-oil after clearing with

* I have not seen the paper of Shakespeare and Norris describing the stain or its properties and capacities and my attention was first directed to it by Bayerl's work on the formation of blood corpuscles on the margins of ossifying zones in bones : *Arch. für Mikr. Anat.* Bd. XXIII. p. 30.

xylol, postponed, but did not prevent, fading. It seems that the essential oils, even in small quantities, possess an oxidising power to which the sulphindigotate of soda is subject.

In order to get the best effects with this stain, the tissues are to be hardened with reagents which preserve the hæmoglobin and its normal distribution in the corpuscles. Some of the ordinary hardening reagents do not fix hæmoglobin (Müller's Fluid and solutions of potassic bichromate), others decompose it (weak solutions of chromic acid), while others again cause the hæmoglobin and the so-called stroma containing it to shrink irregularly in the corpuscles. The very fact that a reagent removes or decomposes the hæmoglobin does not prevent its employment in the study of the mode of formation of the pigment, but points to its usefulness in testing and controlling the results obtained by reagents which fix the hæmoglobin well. For instance, I have used chromic acid for the purpose of removing the hæmoglobin and fixing the antecedent. Even in the list given below the hæmoglobin-fixing property is not the same in all, and again the reagent which fixes the hæmoglobin in the red corpuscles in pieces of the spleen may not have the same property as regards cover-glass preparations of the blood. These facts should be borne in mind in every research on red blood corpuscles. The method which I adopted after a long series of experiments was as follows :—

Small portions of the spleen of *Necturus* were allowed to lie half-an-hour in a saturated solution of corrosive sublimate, or five days in Erlicki's Fluid, or twenty-four hours in a $\frac{1}{6}$—$\frac{1}{3}$% solution of chromic acid, five hours in a saturated solution of picric acid or two to five hours in 1% solution of osmic acid. They were afterwards washed in distilled water and put in alcohol of 50% strength for two hours and then in 70% for twenty-four hours and finally in 95%. The 70% alcohol was changed several times, each at an interval of twenty-four hours in the case of the chromic and picric preparations. The pieces were imbedded, either in mucilage and sectioned on the freezing microtome, or by the chloroform method in paraffin by which sections of about 5—10μ were made. The latter were freed from paraffin with turpentine and passed through absolute alcohol to water in the usual way. These, as well as those prepared with the freezing microtome, were transferred to the Indigo-carmine Fluid and treated in the manner described above.

The great value of these preparations consists in the fact that hæmoglobin is stained grass-green or greenish-blue while other proteid elements are colored red. This grass-green or greenish-blue is shown by a few other elements, but these are so well known and so easily recognised that no confusion can result. The number of structures other than hæmatogenic

to which the Indigo-carmine Fluid gives a grass green color are so few that they may be mentioned here: the yolk spherules, the degenerating, peripherally arranged, nucleolar bodies in the nuclei of maturing amphibian ova, the nuclei of some of the clavate cells in the skin of *Necturus*, also some of the nuclei of some of the cutaneous mucous glands of the same (in chromic acid preparations), the nuclear and cellular elements in the stratum granulosum and stratum lucidum of the epidermis, structures in the sheaths and cellular layers of hair follicles, yolk-like elements in the protoplasmic layer (syncytium) covering the chorionic villi in the cat, the substance of the dim band in striated muscle fibre, and finally, though not so distinctly, the lardacein of amyloid degeneration. It will be seen from this list that except in the Amblystoma larvæ in which there is abundance of yolk spherules, there is no danger of mistaking any other compound for hæmoglobin. Where such a mistake was possible as in the case of the larvæ, I resorted to other staining reagents. From the list given it is to be inferred that the Indigo-carmine Fluid is a valuable reagent for certain processes of cellular degeneration. In connection with striated muscle fibre the reaction is significant, pointing to the derivation in the *Amblystoma* larvæ, of a portion at least of the dim band from the yolk spherules (the hæmatogen of Bunge?) or demonstrating in the dim bands in *Necturus* the presence of the red pigment described as hæmoglobin (Kühne, Ray-Lankester, Levy and Hoppe-Seyler) or as myohæmatin (MacMunn).

I stated that the reaction of the Indigo-carmine Fluid with hæmoglobin results in a grass-green or a greenish-blue color, but, strictly speaking, the greenish-blue color or stain should appear only when the hæmoglobin has been fixed with corrosive sublimate. I omitted to state, moreover, that the antecedent of hæmoglobin gives under certain conditions the grass green color with the staining reagent.

Bayerl* endeavoured in the following way to prove that the substance in the red corpuscles staining grass green with the Indigo-carmine Fluid is hæmoglobin: A quantity of dried amorphous hæmoglobin from dog's blood was dissolved in water, mixed with the indigo-carmine Fluid and the mixture treated with a saturated solution of oxalic acid. The color of the whole was grass-green. This experiment is not so decisive as it appears from the description, for I found that it is only once in a while that a green shade appears in the mixture. I found also on spectroscopic examination of the mixture, that the hæmoglobin was on the addition of oxalic acid more or less rapidly transformed into hæmatin. Even

* Loc cit.

when a quantity of solution B. (see p. 224) alone was mixed with a pure solution of hæmoglobin and the mixture treated with a saturated solution of oxalic acid there resulted only a dirty brownish precipitate from the decomposed hæmoglobin. This proves that soluble hæmoglobin cannot yield any reliable reactions with the Indigo-carmine Fluid.

Acting on the view that the hæmoglobin in my preparation is a fixed insoluble compound and therefore quite different from that obtained for example, by mere crystallization from dog's blood, I modified Bayerl's experiment. I took pure crystallized hæmoglobin from dog's blood, dissolved it in distilled water and mixed it with an equal volume of agar-agar solution* made liquid at 42°C. Stirred rapidly and then cooled by plunging the base of the containing vessel in pounded ice, the deep red agar-agar mixture becomes firm enough to cut with a knife. I made pieces about one-eighth of an inch in thickness which I put in various hardening fluids, as in the case of the spleen of the *Necturus*. When the fixation was complete the excess of the reagent was removed with alcohols 50%, 70% and 90% successively, sections of the pieces were made on the freezing microtome and stained with the Indigo-carmine Fluid. The preparations made with chromic acid or Erlicki's Fluid gave a grass-green reaction while those made with corrosive sublimate gave a greenish blue, practically the same results as in the case of the hæmoglobin in the red corpuscles. The fact that the corrosive sublimate preparations gave a greenish blue color with the Indigo-carmine Fluid, while the other preparations gave a grass-green, would lead one to suspect that there might be a difference in the chemical composition of the reagent when absorbed in the two kinds of preparations. If there is such a difference, it cannot be in the indigo portion of the staining molecule, for blue and grass green sections with the spectroscope, give alike the indigo absorption bands and no more.

I used also in staining sections of the spleen alum-hæmatoxylin solutions, in which ammonia alum is dissolved to saturation, and Czokor's alum-cochineal. These two reagents are of great value, especially the former, in connection with the studies on the hæmatoblasts in the *Amblystoma* larvæ, the latter having been in various stages of their development fixed in chromic acid (⅓%), Flemming's Fluid, corrosive sublimate, and Erlicki's Fluid. Though the other reagents have their uses, the second and third mentioned were the only ones to give good general results. My preference is decidedly for Flemming's Fluid for larval or embryonic tissues. Half an hour is long enough for this reagent to act, since with

* Of the strength and characters recommended by Biondi. *Arch. für Mikr. Anat.* Bd. XXXI., p. 105.

a longer stay in it the yolk-spherules blacken and the chromatin elements in the nuclei are stainable with more difficulty in alum-hæmatoxylin. After the employment of any of the hardening reagents the larvæ were washed for a couple of minutes in distilled water, for ten minutes in 50% alcohol, then in 70% alcohol, until all traces of the hardening reagent were removed, when they were put into and kept in 95% alcohol. The larvæ were, as a rule, and more advantageously, stained *in toto* in alum-hæmatoxylin or alum-cochineal. When the sections, obtained after imbedding by the chloroform-paraffin method, were fixed on the slide with clove oil-collodion, a second stain, eosin, was, when desired, employed. I used, also, the triple and quadruple stains of Gaule for the larvæ as well as for sections of the spleen in *Necturus*, but I cannot say that I have derived any advantage from them.

Cover-glass preparations were made of the blood of the larvæ and of *Necturus*. These were fixed either in the fumes of osmic acid (1% solution for two hours), or by a saturated solution of corrosive sublimate, or picric acid, or by Erlicki's Fluid. These were the only reagents which I found serviceable. The method of operating was to decapitate the living specimen, to allow a small drop of the blood to fall on the cover-glass on which it was evenly spread, then to submerge the cover in corrosive sublimate solution for five minutes, in picric solution for five hours, or in Erlicki's fluid for two days. When osmic acid was used the cover was put, with the preparation surface downward, on the mouth of the unstoppered reagent bottle for two hours. The fixation was completed as usual with alcohol and the various dyes referred to above were used for staining the preparations.

Fresh cover-glass preparations of blood were also extensively studied both before and after the addition of coloring reagents, such as acetic methyl-green, acetic methyl-violet, picrocarmine, &c.

As regards the optical apparatus, I had for the finer work the $\frac{1}{12}$ in. hom. imm. of Leitz, the $\frac{1}{12}$ in. hom. imm. (1·43 N. A.) of Powell and Lealand, the $\frac{1}{8}$ in. hom. imm. and the L. (water imm. $\frac{1}{25}$ in.) of Zeiss. I used during the last summer the 3 mm. apochromatic of the last named maker when studying the blood of the larval *Amblystomata*.

B. STRUCTURE OF THE BLOOD CORPUSCLES IN NECTURUS.

The freshly drawn blood of *Necturus* contains the usual red corpuscles of known form, leucocytes and the so-called fusiform corpuscles. The first and last classes of elements merit a detailed description, owing

to their relation to each other and to the importance of the questions raised in these studies.

The red cells measure 50—53μ in length and 30—32μ in breadth. In the fresh and normal condition they present usually in nucleus and disc a uniform yellow red tint, and in the disc a completely homogeneous discoplasma. There are sometimes corpuscles possessing whitish nuclei which appear contrasted in this respect with the colored disc, but these are not numerous until the preparation has been kept under certain conditions, as in a moist stage, for some time. In such nuclei one can determine the presence of a coarse network. The membrane of the disc is very thin, so much so that when it is ruptured and freed of its contents it is rarely visible. I have frequently, by artificial means, ruptured a large number of the discs in a moist chamber and in only a very few cases was I able to see the resulting free membranes, although there were in such preparations an abundance of free nuclei. The contents of the ruptured corpuscles have different fates. That of the nucleus and of a portion of the protoplasm I shall describe fully when treating of the fusiform corpuscle. The hæmoglobin and the stroma containing it become dissolved in the serum, hardly leaving a trace visible. This points to the fluid character of the discoplasma and I now proceed to prove that view of its structure.

If a cover-glass preparation of the blood is fixed with a saturated solution of corrosive sublimate, stained with hæmatoxylin and eosin, mounted in balsam and studied with the best objectives at one's disposal, the protoplasm of the disc will appear perfectly homogeneous and will be seen stained uniformly and intensely by the eosin. Granules and vacuoles are absent, and if the nuclear membrane is shrunken away from the discoplasma, the edge of the latter next it will then appear regularly and evenly outlined. Vapor of osmic acid fixes the discoplasma in the same way that corrosive sublimate does. This brings out distinctly the fact that there can be no natural separation of stroma and haemoglobin in the discoplasma. In other words, we may say that the latter is not homologous with the cytoplasma and enchylema of ordinary cells, but that in the normal condition it is in the physiological sense a single element. It is true that in certain methods of fixation the protoplasm of the disc appears reticulated, and this may occur in a few of the cells fixed by corrosive sublimate (Fig. 1), but in every case the fineness and arrangement of the reticular trabeculæ depends on the method of fixation, and this shows that the reticulum is artificially produced. One has but to look at Figs. 1, 2, 3, and 4 to see how the artificial structure varies in character. The preparation of the blood

corpuscles of the *Amblystoma* larvæ illustrates this variation also (Figs. 5, and 7), the corpuscles treated with Flemming's fluid frequently presenting a coarse network; those made with acetic methyl-green showing a fine one, while those fixed with osmic acid showed none at all.

If there is a stroma or any network, it does not separate itself from the hæmoglobin, when the latter crystallizes, even in the corpuscle. I have often watched in the moist-stage chamber the crystallization of the hæmoglobin, especially when the instrument permits a slow evaporation of the water of the blood, and found on the border or edge of the drop that the hæmoglobin contents of a single blood corpuscle crystallized without exuding from or passing out of the cell membrane. In some cases the latter was seen to be more and more pushed out at certain points until it possessed a rhomboid form like that of the contained crystal. The membrane became invisible when evaporation passed a certain limit owing no doubt to the greater density of the medium (serum). These crystals are usually of the same length and breadth as the original corpuscle and they contain, moreover, a large central oval space, the cavity of the nucleus. Now these crystals differ in size, but not in form, from those obtained by rupturing the corpuscles and slow drying of the blood. In the latter the crystals are very long and narrow. If there is a stroma why does it not interfere, not only with the crystalline form, but with the power of crystallization in the hæmoglobin?

The nuclei measure 20—21μ by 12μ. With ordinary powers (Zeiss *D*), they appear homogeneous, less deeply shaded than the disc, the hæmoglobin tint which they may appear to have being merely due to that of the superposed portion of the disc, and they often are uncolored or whitish in contrast with the latter. With high powers, such as oil-immersion objectives, one can, in a perfectly normal and fresh corpuscle, determine the existence of a wide-meshed network. This is formed sometimes of thick, sometimes of thin trabeculæ, and it is often straw-yellow in color, in other words, it apparently contains hæmoglobin.

I now leave the description of the red corpuscles to take up the question of the origin of hæmoglobin in them.

C. THE ORIGIN OF THE HÆMOGLOBIN IN THE RED DISCS.

If cover-glass preparations of the blood of *Necturus* or portions of the spleen of the same animal be fixed in various ways it will be found that the hæmoglobin of the red cells in the different preparations is obtained in various degrees of preservation.

One of the most convenient fixative reagents for hæmoglobin in the

red discs, and especially when employed on the spleen, is Erlicki's Fluid. This, combined with the Indigo-carmine Fluid described in the foregoing pages, gives a remarkably sure means by which one can determine the presence of the pigment. The red cells of the spleen present with this fixative reagent and the staining fluid a uniformly grass-green disc in which no structural elements can be observed and a nucleus which may be either carmine red or grass-green, or of a shade in green. Sometimes the nucleus presents a network as deeply grass-green as the substance of the disc, while the substance in the meshes of the net-work is red. These different effects obtained on the nuclear structures are not due to artificial or physical conditions such as the early or late action of the fixative reagent, for all the described features can be found in the nuclei of cells placed side by side. Without raising the question at present whether there is any hæmoglobin in the nucleus, a question which might be prompted by an observation already made above, it may be concluded that the nuclei of the red cells are not all similar in their chemical relations towards sulphindigotate of sodium. This conclusion may be also drawn from a study of cover-glass preparations of blood in which it is often easy to see a grass-green network in the carmine-red nuclei of the red cells.

In cover-glass preparations fixed with osmic acid vapor in which the layer of blood is very thin, the haemoglobin is also well preserved. Here the nuclei of the red cells have, after the employment of Indigo-carmine Fluid, a grass-green network in the meshes of which the substance is faint red. In similar cover-glass preparations in which the layer of blood is comparatively thick the discs of the red cells are grass-green, the nuclei distinctly red with a green net-work. In cover preparations on which the solution (1%), instead of the vapor of osmic acid, was used the same staining reagent gave red nuclei and grass-green discs to the red cells.

In cover preparations of the blood made with corrosive sublimate solutions the Indigo-carmine Fluid stained the discs and nuclear network deep blue green, while the substance in the meshes of the net-work is colored from a light to a deep red, oftener the former. Frequently, with an ordinary power such as a D of Zeiss, very many, or nearly all nuclei of the red cells appear homogeneously red, but with the employment of an oil immersion ($\frac{1}{12}$ in.) the presence of the blue green network can be distinctly determined.

Flemming's Fluid, Müller's Fluid and chromic acid dissolve the hæmoglobin out of the red discs in cover-glass preparations of the blood and

in such cases it is difficult or even impossible to get any reactions at all with the Indigo-carmine Fluid.

In preparations of the blood, therefore, made with corrosive sublimate, osmic vapor, and Erlicki's Fluid, and subsequently stained with the Indigo-carmine Fluid, the nuclei of the red cells are shown to contain two substances: one which stains grass-green or blue-green arranged as a network, the other colored red (light or deep), situated in the spaces formed by the network.

It is now pertinent to ask whether the nuclear network is formed of or contains hæmoglobin, or whether, as it may happen to be chromatin, it, as such, merely shows a special affinity for sodic sulphindigotate, without pointing to any relationship between it and hæmoglobin. I have already stated in the description of the fresh and living red cell that its nucleus frequently presents, under oil-immersion objectives, a straw-yellow network which is seen in contrast with the slight paleness of the rest of the nuclear substance. This would seem to indicate the existence of hæmoglobin in the nuclear network. That it is not hæmoglobin, though a substance allied to it—judging from its color in the fresh cell and its reactions with sodic sulphindigotate in the fixed cell—is shown by the employment of picric acid as a fixative reagent on cover preparations and the use of the Indigo-carmine Fluid. In such the discs of the red cells are somewhat vacuolated but they are colored grass-green while their nuclei are either light red with a deep red network, or, sometimes, light blue with a deep red network. If hæmoglobin is present in the nucleus it ought in picric acid preparations to be as readily detectable there as in the disc.

The question now advanced is: what is the composition of the substance forming the nuclear network and of that filling its meshes?

If a section of the spleen hardened in chromic acid is stained with the Indigo-carmine Fluid, the discs of the red cells appear faint red while their nuclei are colored a deep grass-green. In the latter there is not the slightest trace of a differentiation into network and mesh substance. Evidently then the employment of chromic acid has converted the whole of the nuclear substance into something which stains grass-green with the Indigo-carmine Fluid The latter reagent is not the only one which shows this conversion for alum-hæmatoxylin, alum-cochineal and safranin stain homogeneously the nuclei of the red cells of such preparations. The whole of the nucleus, both network and mesh substance, must be regarded therefore, as modified chromatin or as a mixture of chromatin and achromatin, the latter being rendered capable by the chromic acid of absorbing staining matters. That we have nothing to

do here with achromatic substance is shown in sections of the spleen hardened with Flemming's fluid and stained with alum-hæmatoxylin. In such preparations the nuclei of the red cells take a homogeneous deep stain thus proving that there is no conversion of achromatin into chromatin or into a substance which reacts towards dyes like the latter. Hence we may conclude that the nuclear contents in the red cells are formed of chromatin more or less modified.

If the nuclei of the fully formed red cells in a larval *Amblystoma* hardened in Flemming's Fluid be put under observation, a condition is seen in them similar to that found in the nuclei of the red cells of the spleen hardened in chromic acid, that is, they stain in the majority of cases with alum-hæmatoxylin, alum-cochineal in the same way, taking a uniform homogeneous tint. There can be no doubt that here the nuclei are well preserved. In some larvæ again, there are found a few fully formed corpuscles in which the nuclear network alone is stained. There are also other nuclei in such larvæ which present different amounts of a stainable mesh substance and the inference gained from the study of such nuclei is that the stainable mesh substance takes its origin in the network and as the latter in the newly formed corpuscles contains the whole of the chromatin, the stainable mesh substance is modified chromatin. That it is modified and no longer fully functional may be seen by glancing at Figs. 13 and 14 which represent fully formed red corpuscles of the larva in division. Examples of the latter are not very numerous, not more than three or four occurring in a whole series of sections. In these one finds that there is a quantity of chromatin between the loops of the chromatin figure in the daughter nuclei and that this unorganised chromatin has only taken a passive share in the process of division. The latter species of chromatin was in a few cases so abundant as to obscure the regular chromatin loops.

The substance, then, in the spaces of the nuclear network is a derived chromatin which, fixed with chromic acid or Flemming's Fluid, gives with alum-cochineal or alum-hæmatoxylin a deep and homogeneous stain and which when fixed with chromic acid has the property of giving, as hæmoglobin does, a grass-green stain with the Indigo-carmine Fluid. I believe this modified chromatin is the parent substance of hæmoglobin, that is, it is a true hæmatogen.

That this modified chromatin is derived from the primitive chromatin of the hæmatoblast is also shown by a study of sections from the spleen of *Necturus* hardened in chromic acid and stained with the Indigo-carmine Fluid. Fig. 8 is an exact representation of a group of cells from one of the blood sinuses in such a section, in which a dividing hæmatoblast is

shown with the chromatin loops alone colored grass-green while the cytoplasma and, if present, the caryoplasma are colored, in contrast, light red. There is evidently no derived or modified chromatin here and the only substance related to it must be situated in the chromatin loops. I saw, indeed, in a number of other examples of dividing hæmatoblasts that there was a grass-green substance between the usual chromatin loops and this substance which was, evidently, modified chromatin, varied in quantity from that condition where it was scarcely detectable to that where it was so abundant as to obscure the outlines of the similarly-stained chromatin loops. The latter condition is, certainly, a later stage than that shown in Fig. 8 and the nucleus of the fully formed red cell, in all probability, represents the culmination phase of the conversion of chromatin into hæmatogen.

The chromatin of hæmatoblasts can be shown to be different in composition from that of an ordinary cell. In order to demonstrate this one must resort for material to those *Amblystoma* larvæ in which the majority of the blood corpuscles are more or less pigmented. The latter condition can be readily determined by putting the larva in water on a glass slide and examining its gills through the low power of the microscope. Indeed almost any larva, not very long after its escape from the envelope, will answer the purpose. It is fixed in Flemming's Fluid for half an hour, then put in 50% alcohol for fifteen minutes, afterwards in 70% for twenty-four hours and finally in 95% for four or five hours. If it is stained *in toto* with alum-hæmatoxylin, imbedded in paraffin, sectioned, and the sections mounted in series on the slide in benzol balsam, one can in the concave sides of the aortic arches and in the developing spleen find a large number of dividing hæmatoblasts which at once betray their presence by the dull slate, or slate-brown color which their chromatin possesses, while the chromatin of ordinary cells is stained a tint between purple and navy-blue. Figs. 9 *a* and *b* are contrast drawings made from specimens in the concave side of the same aortic arch and in the same section, the one representing an endothelial cell, the other a hæmatoblast. In the latter the slate-brown color of the cytoplasma was not very marked and this may frequently be found free from any color whatever. No more decisive proof could be given that the chromatin of hæmatoblasts differs chemically from that of ordinary cells. That which gives with the hæmatoxylin a slate-brown color is probably a hæmatogen or hæmatogenous chromatin.

Flemming* has noticed this reaction of the chromatin of the hæmatoblasts on the hæmatoxylin, and he states that dividing hæmatoblasts

* Arch. für Mikr. Anat. Bd. XVI., p. 396 and Taf. XVII., Figs. 19 and 20.

fixed in chromic acid have *in the unstained condition a greenish-brown or brownish-yellow color* which he considers due to hæmoglobin. This color is maintained in the hæmatoxylin staining fluid while all the nuclei of other cells become blue. I also have observed similarly colored hæmatoblasts in chromic acid preparations, and I attributed the color at first to the presence of hæmoglobin. In such preparations, however, there are examples in which the chromatin elements only are greenish-brown or brownish-yellow, and from this condition to that where the brownish-yellow substance is so abundant as to obscure the view of the internal structure of the cell there are all shades of transition. This substance is not hæmoglobin but rather an antecedent of it, that is hæmatogen, and is of the same nature and origin as the modified chromatin in the nuclei of the fully formed red cells which also show the same greenish, greenish-brown or greenish-yellow color when they have been treated with chromic acid. It differs from chromatin in its action on hæmatoxylin and from hæmoglobin in that it is more easily fixed with hardening reagents in the cell, and in that, as I will now show, it has a greater capacity for staining with eosin.

In the preparations of the hæmatoblasts of larval *Amblystomata* fixed with Flemming's Fluid and stained, as described, with hæmatoxylin and afterwards with eosin, one finds the modified chromatin or hæmatogen stained very deeply with the latter reagent. The dividing haematoblasts, according to this reaction, are separable into the following divisions: (1) those in which the cell body is only feebly stained while the chromatin elements are stained deep terra-cotta red (Fig. 10); (2) those in which the cell body is only little less deeply colored terra-cotta red than the chromatin loops (Fig. 11); (3) those in which the staining in the cell body presents conditions transitional between (1) and (2). There can be no doubt that in these forms the eosinophilous substance originates in the chromatin. The hæmatoblasts are the only cells in such preparations which show this decisive eosin reaction.

Now this modified chromatin or hæmatogen, as I prefer to call it, when once secreted into the cell of the hæmatoblast persists there through all the divisions of the latter. This certainly cannot be proved, and I believe it is impossible to prove, but it is a reasonable inference from facts gained by a careful study of the preparations. After a certain stage in larval life, nearly all the hæmatoblasts show it to be present and *it is converted into hæmoglobin when the cycle of divisions has been gone through.* After the formation of hæmatogen once commences it goes on, with the result that each of the numerous daughter or descendant hæmatoblasts possesses by inheritance and through secretion

a quantity of hæmatogen as definitely as it has unmodified chromatin. This hæmatogen plays no part at all in the division, and when the power of division is lost or greatly diminished the unmodified chromatin is confined in the nuclear membrane and the terra-cotta-red stain in the cell body gives place to that characteristic of hæmoglobin.

It has been already observed by Flemming* that chromatin is very abundant in dividing hæmatoblasts, and he compares this great volume with that of the same substance in the fully formed red cells.† He also speculates on the cause of the increase in the quantity of chromatin and mentions two possible explanations: either the stainable substance is taken fromthe protoplasm of the disc into the nucleus or the nuclei of the red cells contain chromatin in a greatly condensed, form so when that division commences it suffices to fill out the enlarged nuclear figure. He, apparently, inclines to the latter view because the nuclei of fully formed red cells stain more deeply than do those of other cells, yet expresses himself as not quite certain that a portion of the protoplasm of the disc does not go into the nuclear figure in division. Strasburger‡ adopts the second explanation. Flemming§ further states that the mitotic figure in the hæmatoblasts is 2—3 times greater than the nucleus of the resting or fully formed cell.

Flemming's observation as to the great amount of chromatin present in the hæmatoblast is correct, but he has used a wrong or incorrect standard when he selected the nucleus of the resting red cell. I have already pointed out that there are two kinds of chromatin in the latter. The network chromatin is never reinforced by that in the spaces of the network and it alone is a direct descendant of the mitotic chromatin of the hæmatoblast. This is very clearly shown by hæmatoblasts one of which is represented in Fig. 14. Now the original chromatin of the hæmatoblasts is from the time of their differentiation as such specially abundant. The quantity of this substance is from this time on to that of the formation of the red cells so great that the hæmatoblast seems hardly capable of containing much else, and, as a consequence, divisions appear so rapidly that I have never yet succeeded in observing the resting stage and the same has been the experience of other observers. There is in this, plainly, a reason for a degeneration of part of the chromatin into the eosinophilous substance already described.

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* Zellsubstanz Kern-und Zelltheilung, p. 262-3.

† The two upper cells represented in his fig. T. p. 263, *op. cit.*, are fully developed blood cells.

‡ Zellbildung und Zelltheilung, 1880, p. 330.

§ Arch. für Mikr. Anat., Bd. XVI, p. 396.

When the amount of chromatin has become so much reduced by division and by degeneration of itself, then and not till then is reached the stage of the fully formed corpuscle. Even in this stage there may be just so much network chromatin left as to prompt a somewhat imperfect division (Figs. 12-14), but these forms are extremely rare and the fully formed red corpuscle is incapable of division henceforth, in other words, it has less than the usual quantity of unmodified chromatin that an ordinary cell has. It may be seen from this that Flemming's theory of the condensation of the chromatin of hæmatoblasts is not supported by the example which he brought forward. The chromatin exists in the hæmatoblasts from the first, there is no condensation of chromatin in the nuclei of red cells, but there is, for the greater part of it, degeneration.

Had Flemming, Pfitzner, and Strasburger studied fully the origin and development of the hæmatoblasts they would, I believe, not have been puzzled by the extraordinary abundance of the chromatin therein and Flemming would hardly have striven to account for this abundance in the way he did, either by derivation out of the cytoplasma, or by expansion of originally condensed chromatin.

From a study of my preparations there can be no doubt that the eosinophilous substance of the hæmatoblasts is, on the one hand, derived from the chromatin and on the other, transformed at the close of hæmatoblastic life into hæmoglobin. The transformation sometimes occurs before this epoch for in the freshly shed blood of larval *Amblystomata* I have seen mitotic haematoblasts in which a faint hæmoglobin coloration was present and in a few other, somewhat deeply pigmented cells the addition of weak acetic acid solution dissolved out the hæmoglobin and showed mitotic figures. This was the rare exception of course. I do not think the eosinophilous substance, although it also deserves to be called hæmatogen, is the same as the interfilar or modified chromatin of the fully formed red cells, for the latter does not react so definitely towards eosin, and it does not as readily affect the hæmatoxylin in the same way. As I have shown, they both, however, are derived from the same source, and, apparently, the eosinophilous substance is farther on the road to the formation of hæmoglobin than the other.

There are a number of facts which also support the view that hæmoglobin is derived from chromatin. Bunge* has extracted from the yolk of hen's egg and from milk, nucleins which contain iron very firmly bound in the nuclein molecule. That found in the yolk Bunge especially calls hæmatogen, because he believes that it is the antecedent of the hæmoglobin of the chick, and he puts forward the view that all the iron

*Ueber die Assimilation des Eisens. Zeit. für Physiol. Chemie, Bd. IX., pp. 49-59.

which enters the animal body for assimilation does so in firm combination with complicated organic compounds, the elaboration of which occurs only in the vegetable kingdom. Such compounds, he contends, when absorbed and assimilated, yield hæmoglobin. Kossel* has corroborated Bunge's observations as to the occurrence of iron in the nucleins of yolk and milk.

Furthermore, Zaleski† found in the livers of various animals, washed out and thoroughly freed from hæmoglobin and inorganic iron salts, proteids which contained iron more or less firmly combined. These were albuminates of iron (Albuminat-verbindung des Eisens), and two, probably three, nucleins containing iron (Nucleo-verbindungen des Eisens). The latter vary in the power with which they hold the iron, and in one of the nucleins which he calls *hepatin* the iron is so firmly combined that the ordinary tests fail to show its presence, *it being only detected in the ash.* This hepatin differs from the hæmatogen of Bunge in that the latter yields up its iron more readily and has a greater amount of the metal, the hæmatogen containing 0·29°/₀, the hepatin 0·011°/₀. Zalesk , moreover, determined that his iron-holding nucleins are present in the nuclei of the hepatic cells.

These nucleins have all the characters of the ordinary nucleins isolated from pus, semen, etc., and as the latter are supposed to be present in, or to form the substance known as chromatin to the cytologist, it is possible that chromation usually if not always contains iron as firmly bound as in the hæmatogen of Bunge and in the hepatin of Zaleski. It is true that the analyses of nucleins, as given generally, do not point to the occurrence of iron, but this can be explained by reference to the method employed in their preparation. The nucleins, or rather chromatins, are soluble in, and after a short time decomposed by, alkalies. Bunge has shown that his hæmatogen loses its iron in solutions of potassic hydrate after some days and contact with ammonic sulphide causes its decomposition with the separation of sulphide of iron. In the preparation of nucleins alkaline fluids have been used to dissolve the residue left by digesting tissues, pus, etc., with pepsin and weak hydrochloric acid, or with hydrochloric acid alone, and the alkaline fluid used contains the nucleins (soluble variety) which one would expect, from the results of Bunge's researches‡ to be free from iron (combined), if originally they contained it. In this way we may explain why the nucleins from various

*Weitere Beiträge zur Chemie des Zellkerns. Zeit. für Physiol. Chemie, Bd. X., p. 249.

†Studien über die Leber. I. Eisengehalt der Leber. Zeit. für Physiol. Chemie, Bd. X., pp. 452-502.

‡See on this subject specially the appendix.

sources analysed by different chemists present so many variations in composition as to lead some observers, Gamgee* amongst them, to deny a chemical individuality to these substances. The nucleins so extracted can hardly be considered as more than derivatives of the chromatin substances, for the latter in the living cell is undoubtedly the seat of the more important vital processes, and the changes resulting in these vital phenomena can hardly occur in a compound so comparatively simple as the nuclein, to which Miescher ascribed the formula $C_{29} H_{49} N_9 P_3 O_{22}$.

I have succeeded during the last summer in definitely demonstrating that the great part, if not the greater part of the yolk of the ovum of the frog and of *Necturus* is derived by diffusion from the chromatin of nucleus of the ovum†. Now this chromatin so diffused is the analogue in amphibian egg of the hæmatogen of the hen's egg. This taken in conjunction with the fact that the iron-holding nuclein of milk can apparently, and possibly, only be the chromatins which Nissen‡ has shown that the degenerating cells of the mammary gland throw out into the lumen of the secreting tubules, distinctly points to the presence of iron firmly combined in the chromatin of every cell.

All these points support and confirm the view that the hæmoglobin of the blood is derived from the chromatin§ of the hæmatoblasts. It may be asked, Why if chromatin contains iron, should not all cells contain hæmoglobin? All cells do not contain the excess which hæmatoblasts have, and therefore have none to spare for transformation into that compound. Why the hæmatoblasts have an excess of chromatin I shall endeavor to show when I come to speak of their origin further on. Enough has been said to show that the compounds which Bunge and Zaleski isolated and called respectively *hæmatogen* and *hepatin* do not merit these names, the hæmatogen not going directly, except probably in developing muscle fibre in larval amphibia, to form hæmoglobin, while Zaleski has not shown that every cell of the body does not contain a nuclein in which the iron is as firmly combined as in the so called *hepatin*.

As an additional proof that hæmoglobin is derived from chromatin, the occurrence of phosphorus in the hæmoglobin of the blood of the goose may be quoted. It is suspected by many that the phosphorus belongs

*Physiological Chemistry of the Animal Body, Vol. I., p. 243.

†The results of the research will be published shortly.

‡Arch. für Mikr. Anat., Bd. XXVI., p. 337.

§I am inclined to believe, from the results of my own observations, that the hæmoglobin of muscle fibre in Amphibia is derived directly from the yolk chromatin or, as Bunge calls it, hæmatogen.

to a compound which, in no way uniting with the hæmoglobin, yet in an admixture with it, is so difficult to separate that after many crystallizations of the hæmoglobin some will always adhere to the crystals. Recently, however, Jacquet* has isolated the hæmoglobin of hen's blood after recrystallization and has found that it contains 0·197% of phosphorus and 0·335% of iron. Hoppe-Seyler had previously found in the hæmoglobin of goose's blood 0·77% of phosphorus and 0·43% of iron. The anomaly of the presence of phosphorus in the hæmoglobin of Avian blood is readily explained away by the fact that the hæmoglobin is derived from a class of proteids which are peculiar in containing phosphorus.

It is, indeed, an important question whether the chromatin of all cells does not act as an oxygen-absorber like hæmoglobin. I made some experiments on this point. Methylene blue in living tissues in which the metabolic processes are vigorous becomes discolored owing to the abstraction of oxygen. This reagent has been recently much used on this account in the determination of the course of nerve fibres. Into solutions of this dye I put a number of free-swimming larval *Amblystomata* and examined them from time to time to determine the effect on the cells of the gills and in the tail. With weak solutions I found the free portions of the membranes only of the epithelial cells colored, while with gradually increasing strength of solution granules in the cytoplasma of the same cells become stained, especially those between the radicles of the cilia on the gills. Sometimes a red blood corpuscle presents in the disc in this case one or more blue granules. If one increases the strength of the reagent almost up to the limit of endurance on the part of the animal, other cytoplasmic elements are stained, but in no instance have I seen a single nuclear body stained. This was not due to slower penetration and, therefore, readier deoxidation, or reduction of the dye, for, in the few examples of epithelial cells in division which I found in that stage in which the nuclear membrane is absent, the chromatin elements were absolutely colorless. Indeed, it is only when the dividing cell is moribund or dead that the chromatin elements stain at all. The probable explanation of the phenomena described is that the chromatin has a marked capacity for storing up oxygen in itself and that it differs from hæmoglobin in that it gives up this element only to the products of its metabolism.

If chromatins and the iron-holding proteids derived from them, like the yolk nuclein of Bunge, have the capacity of storing up oxygen, then it is possible that part of the oxygen required for respiratory purposes in

*Zeit. für Physiol. Chemie., Bd. XIV., pp. 289-296.

the yolk-holding ova may be derived from this source. It is somewhat difficult, otherwise, to explain the process of respiration in larval *Amblystomata* which pass a week or more imbedded deeply in gelatinous masses floating in stagnant ponds.

I have seen, in a few cases, the straw-yellow crystal-like bodies in the immediate neighborhood of the nuclear membrane as Cuenot* has described. I have represented in Fig. 26 the arrangement of the bodies but they are not always as closely applied to the nucleus as there shown, for they, in the greater number of cells in which they were found, lie free in an apparently empty space between nuclear and cell membranes. I regard all these cells, as well as those described by Cuenot—who believes that they indicate the secretion of hæmoglobin from the nucleus—as the products of pathological conditions. I have not seen more than half a dozen of such cells and yet I have diligently examined the fresh blood of several hundred larvæ in various stages of development.

Research demonstrates more and more the influence which the nucleus exercises on the nutrition and function of the cell and among the observations put forward in this line those of Korschelt† may be mentioned, in which it is shown that the formation of chitin is directly dependent on the nucleus. Among the covering cells of the ova of *Nepa* and *Ranatra* the nuclei of two fused cellular elements approach each other and enclose between them a cavity in which chitin is deposited. Platner‡ also considers that the derivation of enzymes in gland cells takes place by the constriction and separation of a portion of the nucleus and the subsequent formation of zymogen granules at the same time that the chromatin of the separated nuclear portion is undergoing degeneration and absorption in the cytoplasma. He believes that there is a direct causal relation between this budding of the nucleus with the subsequent degeneration of the separated part and the formation of zymogen granules. I have failed to find that Platner's description is true so far as formation of zymogen in the pancreatic cells of amphibia is concerned, but I have found, nevertheless, that the nuclei of these cells play a very important part in the elaboration of the zymogen. It is, also, evident from the trend of researches in vegetable cytology that the nuclei of green cells are the important factors in the elaboration of carbohydrates and that the latter are converted into starch in the chlorophyll grains.§

*Comptes Rendus. 1888. p. 673.

†Ueber einige interessante Vorgänge bei der Bildung der Insekeneier. Zeit. für Wiss. Zool., Bd. 45.

‡ Arch. für Mikr. Anat., Bd. XXXIII. p. 180.

§ See on this point Strasburger's Histologische Beiträge. Heft I.: Ueber Kern und Zelltheilung im Pflanzenreiche, pp. 194-204.

II. THE FUSIFORM CORPUSCLES.

The fusiform corpuscles, which measure $26\mu \times 16\mu$, are quite numerous in the shed blood of *Necturus*. They, as their name implies, are elongated and oval, and with usually sharply truncated ends. They have no cell membrane, and their protoplasm, especially at one or both of the ends, is amœboid or protrusible in the form of fine straight rays, which, with careful observation, are sometimes seen to manifest a slow vibratory motion. Sometimes these cells are fixed with the processes extended (Fig. 22*b*). Often the protoplasmic periphery is formed of a series of granules which render the exact outline indistinct. The protoplasm is usually homogeneous, except for the presence of one or more vacuoles at either end of the oval nucleus and a few granules which seem to be of the same character as those of the periphery.

The nucleus is oval usually and measures $16\mu \times 14\mu$. It may in some cases be lobed, and the lobation may have gone so far as to originate several small spherical nuclei. It may be homogeneous or it may be coarsely reticulated. Kept in a moist chamber the reticulated as well as the homogeneous nuclei undergo a process of chromatolysis. In the case of the reticulated nuclei the first stage of degeneration is seen in the trabeculae of the network becoming elongated and parallel, the elongation occurring transversely to the long axis of the nucleus. At the same time the spaces in the network become larger and the nucleus apparently distended. This condition passes into that wherein the whole nuclear substance becomes homogeneous or in which its chromatin forms a thick zone next to the now spherical membrane. The history of the corpuscle terminates with the disintegration of the whole into globules more or less spherical and varying in size, suspended in the serum. Very little of the cytoplasma is found in connection with these globules, for, while the nucleus is passing through the conditions described, the cytoplasma granulates and becomes dissolved in the serum.

Such is the fate of the fusiform corpuscle when it lies by itself. When, however, it meets with another the two fuse, either by their ends, as is commonly the case, or by their sides, and this capacity for fusion may be exercised so much that small masses of them (white thrombi) exist here and there over the field of the preparation. The fusion is complete, all the lines of demarcation disappearing, even the granules which formed the protoplasmic periphery being dissolved.

These corpuscles are free from color and are like the leucocytes in many respects. From the latter they are distinguished by the absence of true amœboid movement and by their regular shape and size.

I have now to discuss the nature of these corpuscles and will first of all detail the various views which have been advanced concerning them in this respect.

It is probable that the first observation of these corpuscles was made by von Recklinghausen* in 1866, who described structures, which could have been no other than fusiform cells, in his preparations undergoing transformation into red cells. He found all the stages of transition between the spindles (fusiform cells) and the elliptical (red) corpuscles, while he saw under favorable conditions in some of the spindles a red shade like that in the ordinary red cells and he regarded these colored spindles as developing red cells. He refers to the fact that in his preparations there are at first small white points, afterwards becoming flat islands (white thrombi?) consisting of contractile cells which attain enormous sizes and possess contractile processes. In these large cells are developed homogeneous, refracting spheres, sometimes to the number of forty, which may, or may not, be considered as endogenously formed cells.

Ranvier† is the next to refer to these elements in frog's blood. He describes them as sometimes sharply pointed at both ends or with one end rounded, the other pointed, finely granular and uncolored. He considers them to be free endothelial cells.

Hayem‡ regards these, as well as the platelets of mammalian blood, as hæmatoblasts. He describes them, as they occur in frog's blood, as smooth, homogeneous, slightly clouded and with a tint less silvery than that of the white corpuscles. They present sometimes a central area lightly shaded, occupying the place of the nucleus, and inside this one or two refracting granules. The nucleus is in every respect like that of the red cell, oval, nucleolated and finely granulated. The disc which is small in volume is flattened, has an elongated, variable form and contains, like the red cells, two distinct constituents, a stroma and a specially organized substance. The stroma is very delicate and, therefore, more difficult to demonstrate than in red cells. The organized matter pervading the stroma differentiates the hæmatoblasts from the red cell, and it is uncolored or faintly tinted with a small quantity of hæmoglobin which it loses easily. This substance is extremely diffusible, and it is endowed with a particular kind of contractility. It is very easily injured, and to this property is due the formation of these corpuscles so readily into granular masses. Hayem subjected frogs to repeated bleedings and

*Ueber die Erzeugung von rothen Blutkörperchen. Arch. für Mikr. Anat., Bd. II., S. 137.

†Traitè technique d'histologie, 1875, p. 191 and 192.

‡Archives de Physiologie, Tome 5, 1878, Tome 6, 1879. Also a later publication: Du Sang et de ses alterations anatomiques. Paris, 1889, pp. 124-151.

found in the blood finally all the intermediate stages between the fusiform and the red cells.

Bizzozero and Torre* reject this view of the hæmatoblastic nature of the red cells and state that though they are like red cells in some respects they are smaller and unpigmented, while young blood cells are round in form and always contain hæmoglobin. These elements are also unlike the leucocytes in their simple oval nucleus and non-contractile protoplasm. These authors believe that the corpuscles in question are related, in spite of many points of dissimilarity, to the structures in mammalian blood known as platelets.

Hlava† considers the fusiform corpuscle to be a variety of the white cell brought about by the contractile capacity of the latter.

Löwit‡ describes the transformation of the spindles into spherical forms like that of the white cells with which he classes these elements. He maintains that all forms of white blood cells may appear in the spindle form, but he admits that certain stages of the developing red cell exist in this form from which hæmoglobin is absent. According to his view the fusiform cell is not a separate species of white blood cell but only a form of the latter which may appear under those conditions offered by the circulating blood, and it may in some cases have a hæmatoblastic nature.

Eberth§ describes the elements as being spindle, club, or almond-shaped, somewhat smaller than the red discs, probably slightly flattened, possessing a finely granulated nucleus and an almost homogeneous cell protoplasm which is chiefly gathered at the poles. Their contour does not change, they have no amœboid processes, and when they are collected into great masses they never present a trace even of a yellow or hæmoglobin tint. When they are kept for hours in their normal physiological condition, *e. g.*, inside the bloodvessels of an excised piece of mesentery, protected from evaporation, they have never been observed to change in shape, they exhibit no amœboid movement whatever and they do not fuse together. In the spindles fixed by osmic acid there is

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*Virchow's Arch., Bd. 90.

†Die Beziehung der Blutplättchen Bizzozero's zur Blutgerinnung und Thrombose. Arch. für Experim. Pathologie, Bd. XVII., 1883.

‡Ueber Neubildung and Zerfall weisser Blutkörperchen. Sitzungsber. der Wiener Akad., Bd. XCII., Abth. III., 1885.

Also: Ueber den dritten Formbestandtheil des Blutes. "Lotos," Jahrbuch für Naturwissenschaft. Prag, 1885.

§Zur Kentniss der Blutkörperchen bei den niedern Wirbelthieren. Festschrift für Kölliker Leipzig, 1887, p. 37.

the longitudinal stripe, or folding, described by Hayem and Bizzozero and Torre and several refracting bodies in the nucleus, with one larger and rounder than the rest to represent a nucleolus.

The spindles undergo change quickly under the microscope with the ordinary conditions of observation. Their protoplasm swells up and disintegrates into a quantity of fine granules which partly dissolve and leave a faint, somewhat irregular body in which the nucleus still persists. The chromatin in the nucleus of the ordinary spindle is more irregular in its arrangement and more fully developed than in the white cells, and it does not form a network as in the latter or in red cells.

As salient points in their character, Eberth emphasizes their colorlessness and their lack of amœboid movement, both of which separate them from the white and red cells. They are not young red blood cells, for these even, in division, contain from their beginning hæmoglobin. That the fusiform cells do not contain even the slightest trace of hæmoglobin is shown by the fact that thick masses of them have not the faintest color, which would not have been the case if some of them contained hæmoglobin. Hayem regarded them as hæmatoblasts in his first paper, but the phenomena of Karyokinesis* in hæmoglobin-holding blood cells was then unknown, and it is probable that he mistook the true hæmoglobin-holding hæmatoblast for the forms intermediate between the fusiform and the red cells.

Eberth does not advance any view as to the origin or nature of the fusiform elements, simply contenting himself with pointing out the analogies between them and the platelets of mammalian blood.

It will be seen by a comparison of the above views that von Recklinghausen and Hayem postulate the presence of hæmoglobin in the fusiform elements while Bizzozero and Torre and Eberth deny this. Again, Hayem and Hlava state that it is contractile and this is expressly opposed by Eberth. Hayem considers them to be hæmatoblasts, with Hlava they are white corpuscles or a variety of the same, while with Bizzozero and Eberth they can only be compared to the platelets of mammalian blood. Such constitutes, in brief, the diversity of views as to their nature.

My own view is that these elements represent the remains of the destroyed or broken up red cells and the following are the facts on which the view is based :

1. Their nuclei are oval and nearly the same in size as those of the red cells ($16\mu \times 14\mu$ and $20\mu \times 12\mu$ respectively). The difference between

*In his more recent work (Du Sang &c.) all reference to these points is omitted.

the two in the latter respect is caused, I maintain, by the nucleus of the fusiform cell enlarging in its transverse diameter and diminishing consequently in its longitudinal diameter. If one keeps a specimen of blood under observation for a while, during which it is protected from evaporation, one finds that the nuclei of the fusiform elements actually undergo this enlargement in its transverse diameter, the transversely placed trabeculæ of its network elongate till the chromatin appears arranged in a number of parallel bars transversely placed. One can, moreover, by sudden pressure on the cover glass, rupture a number of red cells, set free their nuclei which undergo the same series of changes that the nuclei of the fusiform cells do, and shortly after the rupture the nuclei of the red cells measured exactly the same ($16\mu \times 13\mu$ and 14μ). In the free nuclei there is the same transverse enlargement, the chromatolysis and nuclear disintegration.

2. When a number of nuclei of red cells are set free by pressure there is the same tendency to adhere to each other that is so marked in the case of the fusiform element. To each of these free nuclei there is enough of cytoplasma adherent to constitute the cement necessary to agglutinate them together, and in the masses so formed there is nothing to distinguish them from the thrombi formed of fusiform cells. I have not yet succeeded in observing in them any pseudopodial movement, but it is not often that this is observed in the fusiform elements and it is possible that it is the result of a survival from a well nourished condition in the blood vessels, a condition not at all present under the cover glass.

3. The free nuclei and those of the fusiform elements have the same staining reactions. In a cover glass preparation fixed with corrosive sublimate or picric acid, in which free nuclei are abundant, the latter, as well as those of the fusiform cells, give with the Indigo-carmine Fluid a blue-black, sometimes an intense black, and with hæmatoxylin a black reaction. In fact there is the same, or nearly the same stain with all the dyes. There is one important difference so far as the cytoplasma of both is concerned : eosin takes intensely the cytoplasma of the fusiform cells while it stains lightly or not at all the slender protoplasm around the free nuclei. The explanation of this is that the interfilar chromatin (the hæmatogen) of the nucleus of the ruptured red cell gradually diffuses out from the nucleus into the cytoplasma without being converted into hæmoglobin, as it is in the normal corpuscle and that it is this altered chromatin which takes eosin deeply. In some of the fusiform cells there is the same differentiation of the nuclear substance into network and interfilar chromatin, the latter staining deeply with eosin, the former with hæmatoxylin. There can be no doubt about the fact that in such cells

the nuclear chromatin is arranged in the form of a network in every respect like that in the nucleus of the red cell. In such cases one rarely finds the Indigo-carmine Fluid to react as it does in the nuclei of the intact red cells, giving a light red stain to the interfilar chromatin and a green or a blue-green color to network. These are evidently cells which have had but a very short history as fusiform cells, that is, they have been but recently formed, while the other elements which do not show these peculiarities are more pathological by reason of their longer existence as fusiform cells.

4. The nuclei of these elements are admitted by Bizzozero, Hayem, to present resemblances to those of the red cells. These observers, however, took for study the blood of animals in which the red, white and fusiform cells are comparatively small, and consequently were unable to determine the more important points of resemblance.

We can, therefore, on the view that the fusiform elements are the remains of ruptured red cells, explain the absence of a membrane, the capacity for adhering to each other, the similarity in shape, size, structure and staining reactions between their nuclei and those of the red cells when freshly ruptured. We can, moreover, explain their occurrence thereby without referring in any way to the hæmatoblasts or to the leucocytes, and we have also explained to a certain extent the fate of the red cells—what was not done before.

One can readily determine the fate of these fusiform corpuscles even in cover-glass preparations of *Necturus*' blood fixed with osmic acid, picric and especially corrosive sublimate. Fig. 22 *a* represents a fusiform corpuscle in which there is a distinct and coarse chromatin network with a certain amount of interfilar chromatin. At a later stage the trabeculæ of this network become thinner and finally disappear, and when this happens the whole nucleus takes a uniform stain with various dyes. Sometimes the nodal points of this network alone persist and may appear as nucleoli. In the now homogeneous nucleus lobation may ensue (Fig. 22 *c*, *e*. *f*.), and the lobation may go so far, accompanied by a transformation of the shape into that of a more or less round mass, as to render them extremely like leucocytes. They possess now no amœboid properties whatever, and their cytoplasma, which is now comparatively abundant, begins to lose its eosinophilous character while the nuclear chromatin reacts less readily and more feebly to dyes. As such they are broken up, probably in the circulation and more especially in the vessels of the spleen.

As factors operating in the production of the fusiform cells, mechani-

cal conditions inside the blood vessels may be mentioned. It always appeared to me that my cover preparations were far richer in fusiform cells when the blood was obtained from the firmly pressed or squeezed tail of a specimen of *Necturus* than when the blood was simply allowed to drop on the cover glass from the tail tip. Of course there may be other circumstances which serve to increase or diminish the number of fusiform cells in the preparations, but it seems reasonable to suppose that the pressure which is employed between two cover glasses to rupture the red cells can be as effectually exercised in the blood vessels of the intact body. There is, however, another factor which may be less extensive in its effects. I refer to the giant cells in the spleen of the same animal. In a portion of the spleen of a freshly killed *Necturus* teased out, a few giant cells are always observable in which one finds one or more large spherules of hæmoglobin-holding substance imbedded in the cytoplasma. These giant cells are amœboid, and it is, presumably, reasonable to suppose that these masses of hæmoglobin have been removed from the discs of red cells by the invaginating power of the amœboid cells. There is in these same cells no evidence whatever of nuclei, either chromatolysed or intact, which could be considered as derived from the red discs, and the only inference possible is that the nuclei and the remainder of the disc cytoplasma have passed away into the general circulation as fusiform elements. What becomes of them finally after they have passed through the cycle of changes described, whether the leucocytes eat up their disintegrated remains, cannot be determined. I do not know why the nuclei of ruptured red cells do not possess the same amount of peripherally disposed cytoplasma as the fusiform corpuscles do, but it is supposable that either the cytoplasma is deposited from the nucleus or that fully formed fusiform cells are derived from red corpuscles only at a certain time in the life history of the latter, and that the conditions demanded by either of these hypotheses is assisted, in the formation and transformation of the fusiform cells, by the chemical and physiological equilibrium of the blood inside the blood vessels.

We can explain the fate of the leucocytes. No observation has hitherto been made as to the fate of the red cells. My view, I think, presents the easiest and best solution of the question. With it there is no necessity for considering the fusiform elements as hæmatoblasts; it is consistent, furthermore, with Stricker's observations on the transformation of spindles into globular "white" cells* and it specially explains why

* Quoted by Löwit, op. cit.

the fusiform elements are found only in the blood of those animals which contain nucleated red corpuscles.*

III. The Origin of the Hæmatoblasts in Amphibian Embryo.

There is probably no biological subject on which there is a greater diversity of view than that of the origin of the blood corpuscles in the embryo and adult vertebrate. The views on this point have multiplied greatly within the last five years and as they have not much in common, a resumé of them can hardly serve any useful purpose in a paper so limited in its scope as this one is. The observations, nevertheless, which have been already published as to the origin of the hæmatoblasts in Fishes and Amphibia have an important bearing on the facts which I am about to describe and I shall, therefore, give here an outline sketch of them before proceeding with the description of my own observations.

Goette† found the blood cells arise in the mass of the yolk cells. On the under and lateral edges of the yolk mass in Batrachian larvæ blood cells are formed by the breaking up of the large peripheral yolk cells into smaller ones, and at the same time there separates from the inner side of the visceral layer a number of cells forming a covering for the groove in the yolk in which the blood cells are developed. As the interstitial fluidity of the mass increases it extends over the yolk and affects the surrounding tissue just in the same manner as the interstitial fluid shapes the origin of the primary vessels, producing pouch-like diverticula connected with one another, from the yolk vessels. Goette regards the red and white cells of the spleen as direct descendants of the yolk cells.

Davidoff‡ reservedly expresses the view that the yolk spherules give origin by, possibly, protoplasmic transformation to parablastic elements and that the latter develop, in many cases, into blood cells. On this view the nucleus of the blood cell is but a yolk spherule imbedded in a protoplasmic basis, and Davidoff thinks that this is, in a sense, a confirmation of Brass' theory that the chromatin of the nucleus of every cell is secreted or stored up food material.

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* As the red corpuscle in mammalia is comparatively a fragile element its disintegration can scarcely involve the survival of any formed or structural element. If the fusiform element is the nucleus and a small portion of cytoplasma of the red cell in lower vertebrates, we may suppose since the platelets of mammalian blood are recognised generally as the homologues of the fusiform cells that the former are nuclei which have been extruded from hæmatoblasts, an extrusion which Rindfleisch and Howell observed.

† Entwicklungsgeschichte der Unke.

‡ Ueber die Entstehung der rothen Blut Körperchen und den Parablast von Salamandra maculosa. Zoologischer Anzeiger, 1884, s. 453.

Wenckebach* found that in Teleost embryos the blood cells originate from a mass of cells placed under the notochord and between it and the hypoblastic layer. The origin of this cell mass could not be determined, when he published his first paper, but afterwards he traced it to the mesoblast and was able, therefore, to corroborate Ziegler's† first observations on this point. This intermediate cell mass may arise, as in *Belone*, from an impaired organ but in the Salmon it is formed by the fusion of two separate columns of cells. The blood cells are thus, according to Wenckebach, of mesoblastic origin and are not derivable in any way from the hypoblast or from the periblastic cells.

Ziegler‡ confirms Wenckebach's observations on the development of the blood cells in the majority of Teleost embryos out of the cellular elements of the intermediate cell mass placed between the entoderm and chorda. This mass is of mesodermal origin and the cells constituting it wander away over the yolk and, in a measure, as they do this they make the cavities previously occupied by them larger and larger, the cavities forming, finally, the cardinal veins. Up to this time the blood which is free from cellular elements, flows in closed vessels represented at this stage by the heart, aorta, caudal vein and subintestinal veins. The latter empty on the yolk and the blood passes from the posterior surface of the yolk sack to the heart, not in a closed vessel, but free in the space between the yolk and the ectoderm. There arises in the yolk a corresponding furrow to which wandering cells pass to form a vascular wall. These wandering cells are in no way distinguishable from the blood corpuscles of the same stage which are abundant on the surface of the yolk and which arise, as already said, from the elements of the intermediate cell mass. Sometimes, as in the pike, a formation of blood cells, similar to that occurring in the intermediate cell mass, obtains in a portion of the aorta.

According to this view the blood cells are derived from the columns of cells which occupy the position of the developing cardinal and other veins and they are not, except accidentally, and through their amœboid movement, connected with the yolk.

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* The development of the blood corpuscles in the Embryo of Perca fluviatilis. Jour. of Anat. and Phys. Vol. XIX., 1885, p. 231. Also: Beiträge zur Entwicklungsgeschichte der Knochenfische. Arch. für Mikr. Anat., Bd. XXVIII, p. 225.

* Die Embryonale Entwicklung von Salmo Salar. (Inaugural Dissertation). Freiburg, 1882.

* Die Entstehung des Blutes bei Knochenfischembryonen. Arch. für Mikr. Anat., Bd. XXX, s. 596. Also: Die Entstehung des Blutes der Wirbelthiere. Berichte d. Naturforsch. Gesell. zu Freiburg i. B. Bd. IV. s. 171.

Rückert* gives a full description of the origin of the blood cells in Torpedo embryos. He found them to arise in the peripheral mesoblast where they constitute groups situated in cavities formed between the spindle-shaped mesoblastic cells. Where the outer and inner layers of the blastoderm are closely applied to the yolk these groups give off cells which constitute the blood islands of the posterior germinal area. At the latter point, according to Rückert, there can be no doubt about the origin of the blood cells out of the mesoblast. Laterally, and in front where the mesoblast is thin, the formation of the blood and of the vessels occurs through the accession to this part of freshly divided yolk cells (merocytes). Far anteriorly, the merocytes may be very large in size and appear then as megaspheres. The latter may, through unequal, indirect division, budding and fragmentation, give also origin to blood cells and mesoblast.

This brief sketch of the various theories as to the method of blood formation and the origin of blood cells shows how discordant they are. Goette believes that the peripheral yolk cells break up into hæmatoblasts, Davidoff thinks that yolk spherules become the nuclei of the red cells and that the discoplasma is derived from transformed protoplasm of the yolk, Wenckebach and Ziegler considered that the hæmatoblasts are of mesoblastic origin wholly, while Rückert is apparently disposed to believe that they are derived from the yolk cells on the one hand and from the mesoblast on the other.

As far as my observations on the *Amblystoma* larvæ go they are in accord with those of Wenckebach and Ziegler on Teleostean embryos, as to the derivation of the hæmatoblasts from the mesoblast alone.

The first blood corpuscles of the *Amblystoma* larvæ appear at about the twelfth or thirteenth day† after the deposition of the ova. At this date the heart is in the process of formation, the endothelial portions of it being derived from the entoblast in the manner described by Rabl‡ for *Salamandra* and *Triton*. The heart cavity, for thirty-six hours after this, even when fully formed, contains no cellular elements of any sort. The first blood vessels to be formed appear also at the twelfth day, constituting the subintestinal veins§ and it is in association with the formation of these that the hæmatoblasts make their appearance.

* Ueber die Anlage des mittleren Kiemblattes und die erste Blutbildung bei Torpedo. Anat. Anz., 1887, Nos. 4 and 6. Also : Weitere Beiträge zur Keimblattbildung bei Sclachiern. Anat. Anz., 1889, No. 12.

† These dates are only approximate as there is a great variation in the development of the larvæ in the same mass of eggs.

‡ Morph. Jahrbuch, Bd. XII. p. 252.

§ The occurrence of two subintestinal veins instead of one in Selachii was first pointed out by Mayer (Mitth. ans des Zool. Stat. zu Neapel, Vol. VII., p. 340) and subsequently by Rückert (*loc. cit.*)

At about the eleventh day the ventral portion of the mesoblastic plate on each side consists of two layers of cells forming the visceral and parietal portion of the plate. These layers are closely applied to the entoblast and ectoblast respectively, but not at first to each other, for evidences of a slit-like space between them which represents a persistent part of the primitive body cavity, can be very well seen at this date. This slit quickly disappears through the growth of the adjacent parts and the consequent pressure exercised on the mesoblastic cells. The latter are, at first, more or less rounded in outline but the pressure exerted on them gives them a somewhat flattened appearance, except at the lower, extreme margin where the visceral and parietal layers become connected, the cells of the visceral layer here retaining, to a considerable extent, their original shape.

This part of the mesoblast seems to possess a greater capacity for proliferation than the more dorsally placed portions of the ventral half. The proliferation is limited chiefly to the cells at the extremity of the plate and to those immediately above this belonging to the visceral layer. The latter at the point in question is, about the twelfth day, formed of two or more series of cells, those constituting the most internal layer becoming very much flattened and like, in this respect, the cells of the single layer of the parietal portion. The cells placed between are obviously in the position occupied previously by the slit-like space, the more ventrally placed portion of the primary body cavity and as they undergo division more frequently than the other cells, they cause a still greater flattening of the remaining cells of the visceral layer and of those of the parietal portion, with the result that these resemble fully formed endothelial cells. In a transverse section of the larva at about the thirteenth day, taken a short distance behind the developing heart, the cells first described lie in two large masses one on each of the ventro-lateral margins of the entoblast in which depressions exist to contain the masses of cells. The depressions are lined by the flattened endothelial elements derived from the visceral layer which are now recognisable with difficulty, and covered externally by similarly flattened endothelial cells derived from the parietal layer. The visceral and parietal layers above this are still at this time formed each of only one layer of cells more or less flattened. The cells constituting the masses described are the hæmatoblasts, while the depressions in the yolk or entoblast constitute the site of the subintestinal veins.

As the subintestinal veins are followed backwards they are seen to approach, with the mesoblast plates, more and more the middle of the line of the ventral side of the yolk and where the mesoblastic plates from

each side unite in the middle line, the veins form a single channel, til a point immediately in front of the anus is reached. In its course backwards the vessel is filled with cells closely packed and derived, in the same manner as those forward are, from the visceral layer of the mesoblast, although it is more difficult to exclude here the participation of the parietal layer in the formation of the hæmatoblasts. The mesoblastic plates again diverge at the anus and the venous trunk bifurcates, a branch running separately on each side of the cloacal cavity, the cells contained in them becoming less in number till, for lack of them, it is impossible to follow the veins any distance behind the anus.

When these veins and the cellular elements in them have attained the development described the heart is formed and beats. At first it contains no organized elements, the force of the beat being, apparently, exercised on what would appear to be serum. About the fifteenth or sixteenth day cellular elements in every respect like those found in the subintestinal veins are found in large numbers in the heart cavity and as the subintestinal veins are almost empty it is clear that the hæmatoblasts are derived from this source. It is, in fact, easy in series of sagittal sections of larvæ of the fourteenth and fifteenth days to see the detachment of the hæmatoblasts in the anterior portions of the subintestinal veins and their arrival in the heart cavity.

The hæmatoblasts are derived from this source alone. All the other vessels of the body have a different origin, that is, they are not formed by solid columns of cells exerting a pressure on the immediately adjacent mesoblastic elements, but rather by the extension of the subintestinal vessels and of the cavities of the heart. In *Amblystoma* larvæ therefore the hæmatoblasts are of mesoblastic origin alone and they are not increased in numbers by additions from the yolk elements or entoblast.

At first they are large, not differing from mesoblast cells in anything except their somewhat spherical shape. They contain in their cytoplasma a large number of yolk spherules which obscure more or less the nucleus. The latter is somewhat irregular, often amœboid in outline and richer, apparently, in chromatin than the ordinary mesoblastic cells of the same stage of development. To this greater richness in chromatin may be attributed the more abundant proliferation of these cells, for one can see that cell division is more frequent in them than in the neighboring cells. As the quantity of yolk spherules is limited, the repeated division, probably accompanied by a digestive action on the part of the cell on the spherules, produces a form of hæmatoblast (Fig. 16 and 17 *a* and *b*) in which the yolk spherules are few and in which nuclear chromatin is very abundant. It is in this stage that one finds the

hæmatoblast amœboid in outlines. Its cytoplasma is as yet undifferentiated and it does not possess a membrane although the peripheral portion gives evidence of its formation in the presence of a series of regularly arranged granule-like bodies affording a sharply outlined border.

In Figs. 19, 20 and 21 we see the hæmatoblasts of a later stage with much fewer yolk spherules and with specialization of form and structure allied to that in the mature red corpuscle. The outline is oval or elliptical and the peripheral portion is usually limited by a clear hyaline, somewhat thick membrane while the cytoplasma is differentiated into coarse or fine trabeculæ strewn along which are granules, some of them brownish in color like those found occurring in the mesoblastic and ectoblastic cells of this and later stages. Frequently the cytoplasma in the immediate vicinity of the nucleus is denser, stains somewhat more deeply than the remainder while it sends coarse prolongations in a radiating fashion outwards (Fig. 20). The corpuscles are not as yet flattened, but about the twentieth day the majority of them are elliptical in outline and flattened. When the larvæ of this date are fixed with Flemming's Fluid the discoplasma and nuclei of such blood cells are homogeneous, indicating that the latter are fully formed, or mature blood cells. These corpuscles are no longer capable of division and their nuclei give with alum-cochineal a reddish-brown stain and with hæmatoxylin a brown stain, in each case like that given in the red corpuscles of the adult animal. There still persist hæmatoblasts in which karyokinesis is very common and in which no specialization of form, such as that described for the remaining blood cells, is observable. These are the elements from which originate, not only the future blood corpuscles, but also the future hæmatoblasts. These elements form but a small proportion of the whole number of corpuscles and as they possess the power of division while the mature elements do not, the origin of these must now be considered.

In order to determine this, sections of larvæ of the eighteenth and nineteenth days hardened in chromic acid and stained with hæmatoxylin and eosin must be examined. If a section through the sinus venosus be under observation it will be found that that cavity contains a large number of blood corpuscles which, according to the staining effects of the two dyes, can be divided into two classes: one, the more numerous in which both nucleus and cytoplasma show a special affinity for the eosin, the former being often stained only with this dye; the other, comprising corpuscles in the nuclei of which the hæmatoxylin alone has reacted. Both classes of corpuscles are fairly represented in Fig. 15, *a* and *b*, the

greenish elements of the cytoplasma in both being yolk spherules colored by the reduction of the chromic acid. In the corpuscles at this stage karyokinesis is not more common than it is in ordinary tissue cells. It would appear that the more numerous class of corpuscles, *i. e.*, those reacting deeply with eosin, become converted into the mature blood cells existing in the larva up to the twenty-fifth day, for it is these cells only which illustrate the specialization of form and structure already described and partly represented by Figs. 19-21. The cells which react with hæmatoxylin alone constitute the persistent elements which ultimately become the frequently dividing hæmatoblasts of the later stages of development. The eosinophilous cells are apparently in a condition of degeneration, for the division of their nuclei is not always followed by a division of the cell (Fig. 18). Both classes of hæmatoblasts at this time do not specially illustrate division but those which stain with hæmatoxylin only seem to retain the capacity for proliferation while the eosinophilous elements gradually lose it within the next ten days.

At a period which seems to coincide with the formation of the liver as a vascular organ and with the development of tubules in it, the hæmatoblasts, which, from the sixteenth to the nineteenth day, when hardened in chromic acid, stain with hæmatoxylin only, now begin to acquire a capacity for proliferation far in excess of that which they previously had. It would appear that this change is associated with the appearance, in the blood vessels of the body generally and of the liver specially, of a serum which stains very deeply with eosin. This serum stains slightly with alum-cochineal but greenish-blue or green, like the yolk spherules, with the Indigo-carmine Fluid described in the foregoing pages. I regard this staining capacity of the serum as due to the solution of yolk or rather of that constituent of it which has been called hæmatogen by Bunge. This is but a reserve form of chromatin and as the undifferentiated hæmatoblasts float in the serum, it is reasonable to believe that they absorb the dissolved chromatin. It is from this time on that the hæmatoblasts begin to manifest the incessant divisions which characterize the stage represented by Figs. 9, 10 and 11. It is at this time also that the chromatic figures of the hæmatoblasts increase in size. Previously their figures were not larger than those of the other cells of the body. These facts can be explained in no other way than by assuming that the hæmatoblasts surviving as such, absorb the chromatin or "hæmatogen" which is dissolved in the serum and thereby entered on a phase of renewed vitality. The other cells in the body also exhibit divisions now more frequently than before this stage, though not by any means as frequently as the hæmatoblasts, and this increased capacity for proliferation may also be explained

by the more abundant supply of dissolved chromatin in the serum bathing them.

These hæmatoblasts are met with most frequently in those parts of the circulatory apparatus where the blood current is slow or where physical conditions retard their movement. Such conditions are found between the muscle trabeculæ stretching through the heart cavity after these are formed, in the concave portions of the aortic arches and especially in a minute branch of the arteria mesenterica distributed in a plate of tissue derived from the visceral layer of the mesoblast. This is the site for the future spleen. The origin of the spleen in the visceral layer of the mesoblast in the toad was pointed out by Goette* who described the cells of the organ as direct descendants of the yolk cells (entoblastic cells). My observations are not yet concluded in the development of the spleen, but they have progressed so far as to allow me to say definitely that the organ increases in bulk by multiplication of the capillaries arising from the branch of the mesenteric artery to accommodate the excessively large number of hæmatoblasts derived by division from the original hæmatoblasts which have been caught in the narrow spaces of the capillaries, early in development of the organ. At a date roughly corresponding to the interval between the fortieth and sixtieth days, sections of the organ fixed in Flemming's Fluid and stained with hæmatoxylin and eosin, contain a very great number of elements like those represented in Figs. 10 and 11. In fact sections of the organ thus prepared have a deep ochre-red or terra-cotta-red color, owing to the great number of mitotic hæmatoblasts present in it. At later stages of development hæmatoblasts are rarely found elsewhere than in the spleen, which is, from now on, the organ for their production out of the original elements whose history has been traced above and whose presence in the spleen is to be explained as I have pointed out. Whether there is a secondary formation of hæmatoblasts out of the cells of the original tissue of the visceral layer of the mesoblast, it is impossible to say, but as the hæmatoblasts and the spleen are both formed out of portions of visceral layer, such a secondary origin is not, theoretically, improbable. All that I can at present say is that early in the development of the spleen its vascular channels become distended with hæmatoblasts, which are also to be found in other vessels of the body where the blood current is slowed or retarded, that these hæmatoblasts undergo rapid divisions and increase thereby the size of the organ and that these divisions are quite sufficient to explain the occurrence there of all the hæmatoblasts observed. The first appearance of the organ in fact consists in the

* *Loc. cit.* p. 812.

presence of a few hæmatoblasts like those shown in Figs. 10 and 11 in the channel of the branch of the mesenteric artery.

As I have never found in adult caudate Amphibia hæmatoblasts in any other organ than the spleen and then only in its blood sinuses, these may be regarded as direct descendants of the hæmatoblasts which arise by proliferation of the cells of the ventral portion of the visceral plate of the mesoblast.

It is, I think, worthy of note that though there is but one source for all hæmatoblasts, yet there are two stages in their history, the second of which appears when the liver begins to take on its adult structure, the forms belonging to this stage being remarkable for their great capacity for division, while the first series of hæmatoblasts are, almost wholly, formed in the subintestinal veins and the great majority of them are directly converted into red cells, the remainder persisting to form the hæmatoblasts of the second stage.

IV. Conclusions.

1. The hæmoglobin of the blood corpuscles is derived from the abundant nuclear chromatin of the hæmatoblast.

2. The fusiform cells of Amphibian blood are derived from the red corpuscles, the latter in this conversion losing the cell membrane and the greater portion of the discoplasma.

3. The hæmatoblasts in *Amblystoma* are direct descendants of cells split off from the extreme ventral portions of the visceral mesoblast and they pass, at first, a portion of their existence in a specialized part of the original body cavity of the embryo.

V. Appendix.*

The foregoing paper was written, part in 1889, part in 1890. The publication of it now seems opportune since one of the conclusions contained in it has been fully confirmed by the results of my investigations during the last year. *The chromatin of every cell, animal and vegetable, is an iron compound* and this can be proved not only by the use of freshly prepared ammonium sulphide, as described in a communication sent to the Royal Society of London† last year, but also by other methods since discovered, the use of which excludes inorganic and albuminate iron and, at the same time, does not affect the iron in hæmoglobin or hæmatin. With the more recently discovered methods, so easy is their application

* Written Feb. 4, 1892.

† Proceedings, Roy. Soc., Vol. 50, p. 277.

and so definite their reaction, one may make permanently mounted preparations of sections of animal and vegetable tissues, in which the distribution of the chromatin is shown by the iron reaction. The latter may thus be quite readily employed instead of the staining methods with hæmatoxylin and other dyes which, when carefully used, are supposed to select only chromatin. The results which I have obtained with the new methods are so numerous and so important that I must reserve an extended description of them for another paper. *Suffice it at present to say that the fundamental life substance is an iron compound and that, inferentially, the chemical processes underlying life, in other words life itself, are to be referred to the constant oxidation and reduction of the iron of this compound.* This iron-holding compound being present in every living cell, the mystery of the appearance, here and there in animal and vegetable forms, of hæmatin* either free, or attached to a proteid as hæmoglobin, is explained.

It is to be noted further that the iron, though not held in chromatin as firmly as it is in hæmatin, is yet as tenaciously held therein as it is in the ferrocyanides, which also yield, under the same conditions, their iron to ammonium sulphide.

The methods referred to show further that the stainable substance which diffuses from the nuclei and mitotic figures in hæmatoblasts, is an iron compound in which the iron is less firmly held than in hæmoglobin, and that it persists for comparatively a long time as such, before becoming converted into the latter substance. There are also facts which seem to indicate that hæmoglobin is a degeneration product and not a substance formed in the synthetical processes of the hæmatoblasts.

The bearing of these conclusions on the currently accepted views as to the pathology of anæmia is obvious. Since hæmoglobin is a derivative product of chromatin, and since the latter is an iron compound all important in cellular life, anæmia cannot be, primarily, a deficiency in the formation of hæmoglobin, but, first of all, a deficiency in chromatin, not only of hæmatoblasts, but of every cell in the body. In other words the primary cause of all anæmias, other than hæmolytic, is *hypochromatosis* and the condition which Virchow called *hypoplasia* is as much a result of this hypochromatosis, as is the deficiency in formation of hæmoglobin.

Other points arising out of these investigations may be mentioned: the differences between animal and vegetable chromatin and between the chromatin of highly specialized animal cells on the one hand and that of lower forms of animal life, on the other, the occurrence of hæmoglobin

*Linossier and Phipson describe (Comptes Rendus Vol. CXII, pp. 490 and 666) the occurrence of hæmatin-like compounds in *Aspergillus niger* and *Palmella cruenta*.

chiefly in the higher types of animal life, the analogies between chlorophyll and hæmatin and the derivation of the digestive ferments from chromatin.

These and other related subjects I intend to discuss in a future publication.

EXPLANATION OF FIGURES.

Figs. 1–4 are drawn from preparations from the adult *Necturus*, and Figs. 5-7 are taken from larval *Amblystomata* (*A. punctatum*).

Fig. 1. Red disc from a cover-glass preparation of the blood. Corrosive sublimate, Indigo-carmine Fluid—×700.

Fig. 2. Red disc from splenic vein. Chromic acid, Indigo-carmine Fluid—×700.

Fig. 3. Red disc, cover-glass preparation. Chromic acid, Hæmatoxylin, Eosin—×700.

Fig. 4. Red disc cover preparation. Corrosive sublimate, Hæmatoxylin, Eosin—×700.

Fig. 5. Red disc from heart cavity. Flemming's Fluid, Hæmatoxylin, Eosin—×1,000.

Fig. 6. Red disc from gill vessel. Osmic acid, Hæmatoxylin, Eosin—×1,000.

Fig. 7. Cover-glass preparation of red blood cells. Fresh, acetic methyl-green—×1,000.

Fig. 8. Group of blood cells from a vascular sinus in a section of the spleen of *Necturus*. In the centre is represented a hæmatoblast in mitosis and with its chromatin so changed chemically that it takes the sulphindigotate portion of the reagent; *a*, a red disc, *b* a leucocyte. Chromic acid, Indigo-carmine Fluid—×700.

Fig. 9. From a free swimming *Amblystoma* larva.

a, Hæmatoblast from the concave side of one of the aortic arches, in division and showing in the abundant chromatin as well as in the cytoplasma a slate or slate-brown reaction.

b, an endothelial cell from same aortic arch in same preparation undergoing mitosis and showing the normal reaction of the staining fluid.

Flemming's Fluid, Hæmatoxylin—×1000.

Fig. 10. Hæmatoblast from concave side of aortic arch in a free-swimming larval *Amblystoma*. Flemming's Fluid, Hæmatoxylin, Eosin—×1,000.

Fig. 11. Hæmatoblast from same preparation as last—×1,000.

Fig. 12. A dividing hæmatoblast in the last stage of its development, showing two kinds of chromatin in the nuclear figures. Cover-glass preparation, Corrosive sublimate, Hæmatoxylin, Eosin—×1,000.

Figs. 13–14. Hæmatoblasts in the last stage of their development, showing a degenerated chromatin between the regular chromatin loops of the dividing nuclei. From the heart cavity of a free swimming *Amblystoma* larva. Flemming's Fluid, Hæmatoxylin, Eosin—×1,000.

Fig. 15, *a* and *b*. Two hæmatoblasts from the heart cavity of a very young *Amblystoma* larva (not free swimming). Chromic acid, Hæmatoxylin, Eosin. ×1250.

Figs. 16 and 17, *a* and *b*. Amœbiform hæmatoblasts from heart cavity of a very young larva (not free from envelope). The chromatin is very dense in the nuclei. The cavities in the cytoplasma were occupied by yolk spherules.

Flemming's Fluid, Alum-cochineal—×900.

Figs. 18 and 19. Two hæmatoblasts from the heart cavity of very young larva (not free swimming). Cavities in cytoplasma occupied by yolk spherules. Fig. 19 represents a more fully developed corpuscle with well defined contour and abundant chromatin. Chromic acid, Hæmatoxylin, Eosin—×1250.

Fig. 20, *a* and *b*. Two hæmatoblasts, from a very young larval *Amblystoma*, with definite elliptical outlines, uncolored cytoplasma and the nuclei abundantly provided with chromatin. Chromic acid, Hæmatoxylin, Eosin—×900.

Fig. 21, *a* and *b*. Two hæmatoblasts from larva of same age as in last case. Flemming's Fluid, Alum-cochineal—×1200.

Fig. 22, *a—f*. Different forms of fusiform corpuscles met with in the same cover-glass preparation of *Necturus*' blood,—*b* was fixed while exhibiting, apparently, the slow vibratory motion of its thorn-like prolongations. Corrosive sublimate, Hæmatoxylin, Eosin—×1,000.

Fig. 23, *a—d*. Fusiform corpuscles of *Necturus*' blood exhibiting various intra nuclear arrangements of its chromatin. Cover preparation, Picric acid, Safranin.

Fig. 24, *a* and *b*. A hæmatoblast (?) seen at two different optical planes exhibiting the peculiar yellowish granules (hæmoglobin?) apparently like those described by Cuenot as secreted from the nucleus—*a*, at the plane passing through the upper surface of the nucleus, *b*, at the plane passing the centre of the nucleus. There is very little cytoplasma in this cell. Fresh—×1000

1
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3
4
8.
b
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c
d

SIBERIAN INSCRIPTIONS.

By John Campbell, LL.D. Professor in the Presbyterian College, Montreal.

(Read 19th December 1891.)

A wonderfully interesting class of inscriptions, hardly known beyond scientific circles within the bounds of the Russian Empire, is that of the so-called runic monuments of Siberia, and notably of that part of it which is watered by the Yenisei and its tributaries. Several years ago, Mr. Vl. Youferoff of the Imperial Geographical Society at St. Petersburg made, from all available sources published and unpublished, a collection of trustworthy copies of these documents, which I have in my possession, translations of which will be found in my forthcoming book "The Hittite Track in the East." But, in the winter of 1889, I had the satisfaction of receiving, from the Archæological Society of Finland, a folio volume consisting of 52 pages of letterpress and 8 photographs of inscriptions[1]. Of the first part, 17 pages are taken up with an historical account of the discovery of the monuments, illustrated with 14 well-executed engravings; the rest is a representation by the formulated syllabary of 32 complete documents awaiting the zeal of the epigrapher. Such a treasury of ancient Siberian lore never before lay open to the gaze of the historical explorer. The Preface may be trusted to tell the tale of the book, which, I may say for the comfort of students, is written in French.

"The importance, for the archæology and history of Central Asia, of the inscriptions discovered upon raised stones and upon the rocks of the upper Yenisei, has given to the Archæological Society of Finland, the thought of taking the initiative in collecting these inscriptions and in publishing them for scientific ends. Although the work of collection is not yet completed, the society has been unwilling to deprive orientalists of the inscriptions already brought together by the expedition formed for this purpose. This will also explain the incomplete state in which this publication appears. At the time of the work's preparation, the need of possessing photographs taken directly from the inscriptions was deeply felt, for the squeezes made with prepared moist paper could only be made use of in the absence of anything better for the photographic reproduction of the inscriptions. For the same reason, in the text

edited by Mr. J. R. Aspelin, State Archæologist, who took the initiative in collecting the inscriptions, and has taken part, as their chief, in the two expeditions, the writer has limited himself to speaking of the interest which the inscriptions have so far excited. After a first copy of the squeezes, a work in which Mr. Aspelin was able to take part prior to setting out upon the third expedition, Professor O. Donner has kindly undertaken to charge himself with the task of publishing these inscriptions.

"We cannot, at this point, fail to express our gratitude for the encouragement given in Finland by private individuals and by various societies in connection with the preparations for the Society's expeditions, and for the benevolence with which its labours have been seconded by the Russsian authorities, and notably by the Imperial Commission of Archæology.

"The Government of Finland has taken upon itself to provide the expenses of publication by a subsidy which it has had the kindness to grant the Society."

Exceedingly valuable as is Mr. Aspelin's historical introduction, the most complete thing of its kind ever undertaken, its numerous details can hardly be of interest to the general student. The first inscription discovered was on an upright dressed stone, sixteen feet in height, two feet wide and a foot thick, found on the borders of the Ouibat, a tributary of the Abakan by D. G. Messerschmidt in 1721[2]. Messerschmidt, a young naturalist of Dantzig, was then making a tour of exploration in Siberia by order of Peter the Great. In the course of his travels, he fell in with Captain Tabbert, better known by his later title of nobility, Strahlenberg, and it is to the latter's work on the northern and eastern part of Europe and Asia that the world is indebted for an account of Messerschmidt's labours[3]. This work, containing representations of a few other inscriptions, was published in 1730. Little more was effected in the field of Siberian written monuments till the end of the century, when the Empress Catherine II. ordered search to be made for inscriptions, several of which were found and copied by Pallas in the editions of his Neue Nordische Beiträge. From 1818 onwards, George Spassky, Superintendent of mines, betook himself seriously to the task of collecting these documents, new copies of which he published in the Siberian Messenger, and more lately and correctly in the Journal of the Imperial Geographical Society at St. Petersburg. Klaproth, Castren, and Prince Kostroff, continued the work of exploration, but zeal finally died away; and, according to Mr. Aspelin, from 1860 to 1870, nothing at all was done to rescue the ancient records. Since 1870, Siberian

studies have revived in the hands of Messrs. Popoff, Adrianoff, Potanin, and other explorers, through the museum of Minousinsk founded in 1874 by Martianoff; through the Russian Archæological Commission, and Geographical Society; and, far from least, through the Archæological Society of Finland, and its indefatigable Director, Mr. Aspelin, whose published work brings the story of Siberian explorations almost to date.

The Yeniseian, or more generically, the Siberian, inscriptions are, with one obscure exception, that on a fragment of a bronze plate supposed to have been a Chinese mirror, engraved upon stones and rocks, the latter almost always overhanging rivers or streams[4]. They are written or unwritten, the first consisting of regular lines of apparently alphabetic characters, the second being pictographs differing little from those depicted in many parts of the American continent. To the pictorial class, which has no hieroglyphic connection whatsoever, the rock inscriptions chiefly belong; but innumerable stones scattered over the once habitable area of Siberia contain representations rudely executed of men and animals, of hunting and pastoral scenes. Acts of individual warfare are sometimes portrayed, and illustrations of copper cauldrons with human figures dancing round them are supposed to connect with northern magic[5]. A finer kind of sculpture, sometimes in intaglio, but oftener in bold relief approaching the statuesque, appears generally in connection with the written character. When it represents the human features, it was evidently intended as a portrait of the occupant of the grave mound over which the stone that bears it was originally reared. Some sepulchral stones are void of ornament; on others there are reindeer and other animal effigies; and on others the portrayed face is so barely and grotesquely human that it may be regarded as an object of idolatrous worship. The number of stones engraved with written characters, accompanied or unaccompanied with other ornamentation, is probably but little over forty, of which Mr. Aspelin figures thirty-two. It does not necessarily follow that all of these, whether found in a standing position or lying flat upon the surface of the ground, are sepulchral in character. Some contain Buddhist emblems, and, were I to anticipate the results of personal decipherment, it would appear that several of them are inscribed with proclamations relating to the worship of Gotama, which were probably engraved on portions of religious buildings that have fallen to decay.

The Yenisei country is one of thick strewn mounds, mounds by no means so ambitious in size and variation of outline as many of those which are scattered over the Ohio and Mississippi valleys; but, in so far as they are sepulchral, of the same nature, the chambered tumulus of

Asia being identical with that of America, even to its cinder layers, its log walls, and its birch bark coverings[6]. The Russian archæologists trace the continuity of the Siberian mounds and sculptures from the ancient Scythic region north of the Black Sea, through the Caucasus and the shores of the Caspian, onward to the Yenisei. Their conjectures as to the origin of the old civilization these represent, and especially as to the derivation of the Siberian runes, have been numerous and varied. Much of Mr. Aspelin's Introduction is taken up with the history of these diverse theories. The first to venture an opinion was the Russian Academician, Th. S. Bayer. He thought he saw some resemblance between the Siberian and the old Russian characters, and the latter he derived from an ancient Iberic alphabet that, while marking a transition between Greek and Armenian writing, at the same time displayed traces of Egyptian influence resulting from the Egyptian colony of Colchis, which stands on the authority of Herodotus. It would be a very simple matter to ridicule the Academician, but ridicule is not argument. Leaving the Colchian colony out of account, there is archæological evidence of the identity of a Caucasian people with the builders of the Yeniseian mounds; but the Iberic alphabet unhappily is to seek. Strahlenberg imagined the characters to be of Scythic or of Parthian origin. The Scythic alphabet is unknown; but the Parthian is found on coins, and has many points of contact with the Siberian. Pallas was divided in opinion between Ancient Greek, Phœnician, and Etrurian. His friend, the philologist Tychsen, favoured a Scythic origin, and found intimate resemblances between the Siberian characters and the Sinaitic, referring the latter to the Scythic invasion of Palestine and Egypt in the time of Pharaoh Hophra. Tychsen's date for the Sinaitic inscriptions is far too low, for it can be proved that the syllabary in which they are written is the parent of a great family of Turanian alphabets[7]. Abel Remusat, calling the Siberian characters Indo-Gothic, derives them from the Devanagari or Sanscrit; but he also suggests that the Kitan and other northern Asiatic tribes may have created them out of modified Chinese symbols and have passed them on to Corea and Japan[8]. Rommel allies the Yeniseian writing with that of the Huns found in Hesse. Klaproth regards the system as more European than Asiatic, and imagines that it came in with the Hakas, a Tartar tribe, who derived it either immediately from the Byzantine missionaries, Cyrillus and Methodius, or mediately through the Kirghis. But time would fail to set in order the many unproved hypotheses concerning the origin of the Siberian documents, hypotheses which, up to the present day, have been entirely barren of results.

The chief reason for lack of success in interpreting the Siberian in-

scriptions is that investigators have persisted in affiliating the unknown with the unknown. The language of the Sinaitic inscriptions, of the apocryphal Iberic and Scythic, of the Parthian, of those of western Asia Minor, of the Etruscan, and of the Hunnic, is as much a mystery as that of the Siberian. To draw attention to resemblances among these modes of writing is perfectly justifiable and scientific, and, in the course of time, may lead to large results. But, in the meantime, what is wanted is a standpoint of known phonetic equivalents of Turanian characters. Inasmuch as my process has been for some time before the public, and as the full statement of it, as regards the Siberian characters, is soon to appear in the work already referred to, it would be idle and superfluous to recapitulate these within the necessarily brief limits of this paper[9]. The language of the inscriptions being *a priori* unknown, the history they record a blank, without the aid of a bilingual, however brief, no guess work, ever so brilliant, could lead the student to a consistent lexical and grammatical interpretation of them in a well known oriental tongue. That tongue is the Japanese, in a dialect varying but little from the written or literary speech of the present day. The suggestions of Strahlenberg and other writers, that the Siberian characters are related to those of the Sinaitic and Etruscan, of the Parthian and Devanagari, inscriptions, and that they were carried by the Kitan in a modified form into Corea, are justified by the linguistic and historical facts which all of these documents unfold, when the key that unlocks the door of long Siberian silence is applied in turn to them.

Mr. Aspelin counts 42 distinct characters in the inscriptions examined by him. Had he distinguished all the varieties of form presented, he could have made them much more numerous, but as no special law can be found to govern the variations, the number must practically be much reduced, especially, also, as they are found to be not alphabetic but syllabic, and to dispense with the vowel notation common to the Lat Indian and Corean systems. A careful analysis of several inscriptions in which proper names are repeated reveals the fact that characters of radically diverse origin were phonetically interchangeable, a fact which simplifies the reading of such documents, but which robs the syllabary of that nice distinction of vowel values which the numerous symbols would lead one to expect, and which would render definite the pronunciation of the words they compose[10]. An instance of this is the commonly recurring word for a king, which, judging from present usage should be *mi-to* or *mi-kado*, the sublime porte, or honourable door. In point of fact, the first character which represents it, as a rule, has not the phonetic value of *mi*, *me*, which is set forth by a different symbol, and the second, of varying form, may as often be read *ta*, and *te*, as *to* or

do. While such phonetic inaccuracy is unfortunate, no one acquainted with ancient modes of writing will find in it any cause for surprise or doubt. The Siberian characters are conventional forms of ancient hieroglyphics, as were the old Semitic letters, and as the scribes of early days employed many symbols to denote the same sound, such as a leg, a fish, a mountain, for the sound *me*, so the writers of the conventional character indicated this same phonetic value by several distinct engraved forms One of the commonest Siberian emblems is the fish, denoting an *m* syllable[11].

Coming now to the representations of the inscriptions by means of Siberian type, it unhappily appears that Mr. Aspelin or Professor Donner, whoever may be responsible for the new font, has been premature in his application of it. Several of the inscriptions deciphered by me are contained in Inscriptions de l'Ienissei, but the two rarely coincide. The copies furnished to me are in large characters carefully copied from the originals, while, save in the necessarily somewhat indistinct photographs at the end of the Helsingfors volume, there is no attempt in it at an exact reproduction of the features of the inscribed stones. The consequences are that the font of Siberian type is defective, that aberrant characters are represented by their nearest equivalents in form, that flaws in the stones are mistaken for parts of symbols, that the common sign for a vowel, a perpendicular line, has been taken for the colon like divider of words and clauses, and many other regrettable obstacles in the way of correct decipherment. These errors are not to be wondered at, when the weathering of the stones, the occasional rudeness of their carving, the latitude allowed themselves by the engravers, and the absolute ignorance of the phonetic values of the characters on the part of those who have conventionally expressed them in imperfect type, are taken into account. Nevertheless, it is to be confessed, with sorrow, that time spent upon Messrs. Aspelin and Donner's printed copies will be largely wasted, since few decipherers will be patient enough to seek for conjectural emendations, or bold enough to make these in the face of clear cut printed characters possessing phonetic values entirely different from the originals. In the meantime, what is wanted is carefully executed lithographs of the inscriptions, exhibiting cracks and flaws in the stones, imperfect strokes, and aberrant characters. The motto, *festina lente*, valuable in so many connections, is especially so in that of epigraphy, wherein so much depends on the value of a single character. An inscription in legible characters which can only be read fragmentarily is not read at all; at any rate, its reading inspires the reverse of confidence. It is as painful and disappointing for me to draw attention to these defects in Inscriptions de l'Ienissei, as it can be for the devoted

workers of the Société Finlandaise d'Archæologie to contemplate the partial failure of their too premature and ambitious attempt to render inscribed characters by movable type. Had the attempt succeeded, it would have been a triumph; as it is, love's labour is by no means altogether lost.

In the accompanying plates, which set forth, at once, the phonetic values of the Siberian characters, and a comparison of three inscriptions, as represented in Inscriptions de l'Ienissei, with the copies of the same made by M. Youferoff, the extent of the divergence between the two renderings is quite apparent, even to the superficial examiner. No. XX, as copied by M. Youferoff, reads:

No. XX.

Part I. Line 1. me ku ba to ba i: mi to me to me: i ku me ku ba
2. ka do· mi· to ji ta chi: aba ta ba mi do ku bu ji tsu ka
3. sa go ta yo ba ka me chi ji ta shi ta: mo shi dzu ta
4. ra ba ma me Buda: ba i to gu ku mo mi
5. kei ku ku da ta

Part II. Line 1. ta: gi ri ga fu ju
2. to ji tsu ka: sai do to ji ku
3. ya me to ba i: mi ta sa go ta TSU
4. gi: mi to shi dzu ta ku bi ri be ku de

The same as given in Inscriptions de l'Ienissei:

Part I. Line 1. me ku ba to ba i: mi to me to me: *ba ki* me ku *ta*
2. do mi: to ji ta chi: *no* ta ba *dzu* do ku bu ji tsu ka
3. *ta* sa go ta: ba ka me chi ji ta shi ta: mo dzu ta
4. ra ba ma me *shi do*: *no* i to gu ku mo mi
5. *ka ki no to* da ta

Part II. Line 1. *i*: *sa* ri *i* fu ju
2. to ji tsu ka: *ne* do to ji ku
3. *shi*: me to ba i: mi ta sa go ta TSU
4. *me*: mi to shi dzu ta ku: bi ri be ku *i*

Literal translation of No. XX. according to M. Youferoff's version.

Part I. *Mekuba tobai: mito Metome: iku Mekuba*
Mekuba's consort: king Metome: buries Mekuba
Kado: mi: toji tachi: abatta ba imi doku buji tsuka
door: behold: shut stands: defended may malice injury safe tomb.
Sagota Yobakame chijitashita: mo Shidzuta
Sagota Yobakame ruler under: even Shidzuta

Raba mame Buda: bai to gukumomi
Raba people Budha: priest company learned
Keiku kudatta
guard has committed.

Part II. *Ta: giri ga fuju*
who: righteousness of bereft
toji tsuka: saido tojiku
closed tomb: a second time uncloses
yame tobai: mito Sagota tsu—
widow's consort: King Sagota's successor
gi: mito Shidzuta kubiri beku de 12
King Shidzuta hang should not.

Freely: "Mekuba buries king Metome, Mekuba's consort. Behold! the door stands shut; may the tomb be kept free from injury. Sagota's subordinate ruler of Yobakami, even Shidzuta, has committed the guardianship to the learned company of Budha's priests of the Raba people.

"Him, who, bereft of righteousness, forces open the closed tomb, the consort of the widow, the successor of King Sagota, King Shidzuta, ought he not to hang?"

M. Youferoff's copy of the inscription furnishes classical and grammatical Japanese, if somewhat archaic; simple common sense language, appropriate to a tombstone; and idioms and historical references common to the whole series of Siberian inscriptions. The emendations, if they ought so to be called, of Messrs. Aspelin and Donner, are at variance with all of these. These estimable gentlemen, to whom so great credit is due for their arduous and unselfish labours, have, in spite of themselves, been guilty of theorizing in regard to the equivalency of certain signs, and all unwittingly, have furnished the student with an impure text, on the basis of which progress is almost impossible. Higher criticism in the region of the unknown is invariably certain to bring its author to grief, as it has brought Dr. Sayce, and other students of the Hittite hieroglyphics, such as Dr. Hayes Ward, in their comparisons of groups, of the phonetic values of which they were in utter ignorance. A badly written R may look like an A, but it is R all the same, and an imperfect G may resemble a C without being such; these are the mistakes of mankind in general, who allow the eye to take the place of the mind, until logic makes demands which no mere ocular comparison can satisfy, and thus demonstrates the futility of their process.

The divergence in certain parts between No. XVIII in Inscriptions de l'Ienissei and the same in M. Youferoff's collection, is so marked as, at

first sight, to make it doubtful that the inscription has been truly copied. The former version differs little from those published by Castren and Spassky, while the latter is the work of M. Adrianoff, a much more recent and more scientific examiner. M. Adrianoff seems to have contented himself with the presentation of faithful and minutely exact copies of his originals as he found them. I am not aware that he has indulged in hypotheses regarding the inscriptions, nor have I, so far, any evidence that he has entered on the somewhat dangerous path of the conjectural emendator and filler up of lacunae. The inference that Castren and Spassky erred in this respect is easier to draw than to substantiate; their mistake seems rather to have been a confusing of the contents of lines of writing so irregularly arranged as to make it difficult to avoid running the one into the other. Of this the reader can judge by the plate, setting forth the two diverse copies and by the subjoined transliteration and translation.

No. XVIII in Inscriptions de l'Ienissei, as copied by M. Adrianoff:

Line 1. ta to bi Buda a no ta ko go i no Buda ji be i mi to sa go ta : ma ru ta ku ma do tsu be
Line 2. shi ta sa go ta no ka mi to ba i : fu de shi ta i ku da ki beri a to ta DZU
Line 3. Buda a no ta hi ro me ku : ta da sha : mi to sa go ta yo bi da ta hi me ku o ma ka dzu
Line 4. ta 3 go hi yo shi go ne ri to shi ga gashita ji go mi ha dzu ya ku Buda
Line 5. de shi ta sa go ta ri mo koko no te : mo 3 fu ta to Buda shi go } invert
Line 6. mi te ma to ku baba do ri dzu me

The same as given in Inscriptions de l'Ienissei:

Line 1. mi mi a tsu no : ka : no Buda shi? : mi to sa go ta : ma ru ta ku ma do tsu ka
Line 2. mi to sa go ta : no mi ko bai : fu de shi ta : kudaki ri a to ta DZU
Line 3. mi to sa go ta : ro dzu ki : shi chi da sha : mi to sa go ta : na ma ko yo : me shi ka : ma ku dzu
Line 4. shi chi ku dzu : a tsu ba ku dzu
Line 5. ka ya to ta : ka te 3 ku ka ta Buda : ka ri ta ka : ka shi to be fu ta ta Buda shi go
Line 6. mi : yo dzu ta sa go ta ri mo mi no te : mo 3 u ta
Line 7. ki mi te be mi ka : ri dzu me

Literal translation of No. XVIII according to M. Youferoff's (M. Adrianoff's) version:

Line 1. *Tattobi Buda Anota kogo ino Buda ji bei mito Sagota : maru taku mado tsube—*
honour Budha Anota press prayer Budha temple companion King Sagota : round house foundation destroy

Line 2. *—shita Sagota no kami tobai: fu deshi tai kudaki beri atota DZU*
did Sagota of lordly companion : law disciple desire broken ruin to raise up

Line 3. *Buda Anota hiromeku : tadasha : mito Sagota yobidata himku omakadzu*
Budha Anota proclaiming: righteous: king Sagota has convoked poor rich

Line 4. *Ta 3 gohiyo shigo ne ri toshi ga gashita jigo mihadzu yaku Buda*
who 3 day's labour work will 300 years of united deeds overlook promises Budha

Line 5. *Deshita Sagota ari mo kokonote : mo 3 futa to Buda shi go*
became a disciple Sagota is even 9 100 3 20 10 Budha death after

Line 6. *Mite matoku wabi do ri dzume* [13]
see approve peace path reason convinced

Freely: "The companions of the temple of Budha petition King Sagota to honour Budha Anota. The noble consort of Sagota has broken down the foundation of the Round House. The disciples of the Law desire to raise up the broken down ruin. The righteous King Sagota, proclaiming Budha Anota, has summoned the poor and the rich.

"Of him who will do three day's work Budha promises to overlook the united deeds of 300 years. When Sagota became a disciple, it was even nine hundred, three score and ten after the death of Budha.

"See that ye approve the path of peace, being convinced by reason."

Still another inscription, and a brief one, is line 10 of No. XVII in Inscriptions de l'Ienissei. It is within a circle, embracing a triangle that contains a Budhist hat surmounted by a cross. Even in this simple document, Messrs. Aspelin and Donner have gone astray, by turning unmistakable *no* or *na* into *to*. Such an error in so simple a document involves the whole of their printed inscriptions in uncertainty, and takes away all heart from him who, by their means, would fain penetrate the obscurity of the Siberian past.

M. Youferoff's version of No. XVII, line 10, in Inscriptions de l'Ienissei:

No. XVII. line 10. Shu Buda to ta ku no da na sa ku shi ba ta

The same in Inscriptions de l'Ienissei:

Shu Buda to taku to da to sa ku shi ba ta

Literal translation of No. XVII. line 10, acording to M. Youferoff:

Shu Buda to taku no dansaku Shibata
Lord Budha company house of founder Shibata [14]

Freely: "Shibata, founder of the house of the company of Lord Budha."

These three documents are, I think, sufficient to justify my contention that Messrs. Aspelin and Donner have been premature in converting the varied written forms of the old Siberian character into printer's type. My object in setting them forth is not that of the carping critic, nor a desire to depreciate in the least degree the eminent labours of the Finnish scholars to whose courtesy I am indebted for the elegant volume with which this paper deals. It is rather to draw the attention of these gentlemen, and of others interested in the same studies, in such a way as only a printed and illustrated treatise can draw it, to the unavoidable inaccuracies of their present process, in the hope that the love of scientific truth and zeal for Siberian research, which so far has honourably characterized their work, may induce them to favour students with absolute fac-similes of the precious inscriptions, which, with untiring energy, they have collected from many quarters.

The full text of over twenty Siberian Inscriptions, including those under consideration, will be found in my forthcoming work The Hittite Track in the East, accompanied by an account of the discovery of the phonetic values of the characters, and ample grammatical and historical notes. I have, however, thought it wise to forestall the information therein contained, by appending lexical and grammatical notes to the inscriptions dealt with in this paper, using for that purpose Dr. Hepburn's Japanese Dictionary and Mr. Aston's Grammar of the Japanese Written Language. As the writers of the Siberian character were really the most important element that subsequently, in their descendants, occupied the Japanese Islands, it almost necessarily follows that their history has a place in the Japanese annals, which, however, like most ancient documents dealing with the period of a nation's infancy, are silent concerning the story of migration, although Japanese writers are not wanting to derive their race from northern India. For the history, therefore, I make use of Titsingh's translation of the Nipon O Dai Itsi Ran, or Annals of the Emperors of Japan. In the Hittite Track in the East, this history will be farther elucidated by chronologi-

cally anterior data furnished by Indian Budhist inscriptions and native histories, and by materials contributed in the annals of the Chinese dynasties, and in the San Kokf Tsu Ran To Sets, so far as it relates to the peninsula of Corea.

The oldest and most important royal name in the inscriptions which have been under consideration is that of King Sagota. In other inscriptions, he and his successors are called Kings of the Kita in various divisions, such as the Raba-kita and the Yoba-kita. These are the Khitan of the Chinese historians, who are said to have occupied northern China from before the middle of the tenth century until 1123 A.D[15]. One of the earliest Khitan emperors of China, from whose dynastic title Marco Polo picked up the name Cathay, was Shekingtang, the founder of the sub-dynasty of the How-Tsin in 936. His successor was Tsewang or Chuh-Te, and his, Le-Tsung-e, who is called a prince of How. She-King-Tang, a brave general and wise administrator, adopted the name of Kaou-Tsoo. In more than one Siberian inscription, the successor of Sagota is called Dzuta or Shidzuta, a name sufficiently like that of Chuh-Te, the successor of She-King-Tang, to demand attention. The ancestry of Shekingtang or Sheketang is not given by the Chinese historians, who represent him as a man of low extraction, but his immediate predecessors were Ming tsung and his son Minte. It is very evident that the Leaous, Hows, and Khitan, under Sheketang and Chuhte, are the people, who, in the end of the fifth century, dwelt between the Obi and the Yenisei in Siberia; but Sheketang and Chuhte belong, according to the Chinese annals, to the first half of the tenth century[16]. Yet the Khitan were in Liaou-Tung long before, for the historians of Corea state that they took possession of the northern part of that peninsula between 684 and 689, or 250 years earlier, although still 200 years later than the dated inscription of Sagota[17]. The Khitan were strangers, invaders, and conquerors of China, whither they brought not only their customs, language, and religion, but also their annals, including the names of their former kings, Sagota and Dzuta. The Chinese historians, without question, copied the names of these and other kings, buried under Siberian tumuli, with some facts of their reigns, as if they had been rulers in the Celestial Empire, equally with their successors of four centuries later. There may, of course, have been a later Sagota with a son or successor Dzuta, named after those of Siberia, for the tendency of the Khitan is to repeat names of illustrious persons from generation to generation, but the probability is that these Siberian kings are the Chinese Sheketang and Chuhte of the Khitan.

The Japanese Sagota is called Saga-no-teno or Sagateno, and he is

the Chinese Sheketang or Shekingtang. He is said to have reigned from 810 to 823, more than three centuries too late. Sagateno or simply Saga, for the final *teno* means "emperor," is, in Japanese history, made the second son of Kwan-mu, and the successor of Fei-zei[18]. But the story of an insurrection against his authority by Fei-zei, who, with his son Take-Oka were compelled to shave their heads and become priests, although the latter had been appointed Taishi or heir-apparent, gives to Saga's reign the appearence of an usurpation. The emperor dwelt at Siga in the province of Oomi, which, with those of Ize and Mino, seem to have been his chief care. His hunting grounds were Owara, Tarizen, Mitsunari, Katano, Serigawa, and Oigawa. If these are to be recognized in Siberia, Oomi may be Omsk, and Mino, Minusinsk. Then the Koibal steppe would answer to Owara, Turuchansk to Tarizen, and Saragatch to Serigawa. Sagateno worshipped heathen gods, and invoked them for rain and fair weather; but he had an hospital built for the Budhist priest Kobo near the temple Kobuksi, and called it Nanyendo. To the same priest he gave the temple of Tosi, and to another, that of Saisi. It may be that Saisi is the very Schouscha in which the stone that tells of Sagota's conversion was left by Castren. There is no record of any destruction of temples by Sagateno's Taishis, of whom the first became a priest, and the second was a zealous Budhist. He was himself a lover of literature, a poet, an orator, and a legislator. He inspired his people with a taste for flowers, and spent much time in his own garden, Sinzenyen. Many incidents in his history indicate a simple and primitive sort of life.

Sagateno's successor was his younger brother, named Otomo-no-Sino, and he, apparently, is the same person as the Metome of the inscriptions; for O-tomo means "the great or honourable companion," and such also is the signification of Mi-tomo. He was a lover of science, composed verses, and wrote excellently. A zealous Budhist, he gave to the priest, Ghisin, the temple of Yenriaksi for the observance of the Budhist rites called Tendai, and built a tower, apparently for the protection of the temple Tosi. His reign was a peaceful one, marked by an improvement in agriculture, to facilitate which he had hydraulic contrivances made all over the country for the irrigation of the cultivated land. He was in the habit of convoking the learned men of his kingdom, to learn from them the progress made by their scholars, to collect the ancient poems of the nation, to write chronicles, and read the books of the law. He collected a library of a thousand volumes, and in many other ways encouraged literature. The Japanese annals do not name the wife of Otomo, whose importance is vouched for by the frequent mention of her name in extant inscriptions, and especially by the statement of Shidzuta that she was

his co-regent. Her name Mekuba is something like that of Mikifito-no-Naisino, daughter of the emperor Kwonin, and, therefore, the aunt of Sagateno and Otomo[19]. Mekuba was probably related in some way to Sagota, being, perhaps, his daughter, although the monuments make no statement to that effect; but her name is so prominent on them, along with those of Sagota, Metome, and Dzuta, as to leave the impression that she had royal claims superior to those of a mere consort. It is unfortunate that so little is recorded of this Budhist queen or empress whose deeds of beneficence and piety have, in all likelihood, been transferred by the Japanese historians to the widow of Sagateno. That widow died at the age of 65, and after her death her name was honoured as that of a saint. Now, had the queen of Sagateno really been such a patroness of Budhism, it is hardly likely that the priests who composed the proclamation to rebuild their temple would have omitted the name of their benefactor, since that name would have been a sanction for the demand of the document, as valuable in the eyes of the Budhists among the people as that of Sagota himself. The names of Sagateno's queen may be correctly given as Tatsibana-no-Fushin Kaghesi and Danrin Kwogu, but her daughter, unnamed in the history, will be the Mekuba of the inscriptions and the true votary of Budhism.

Another Siberian inscription contains the statement of Dzuta's or Shidzuta's assssination. The only person whose story in the Japanese annals at all coincides with his is Tsune-Sada, the son of Otomo, who was accused of revolting against Masa-Yosi or Nin-Mio, the son of Sagateno, and was deprived of the succession in consequence, when he is said to have become a priest[20]. Such particulars as can be gathered concerning him will be found in The Hittite Track in the East. There remains King Shibata. His Japanese name is Seiwateno, and he is called the son of Bun-tok, who was Sagateno's grandson. On the maternal side he belonged to the famous family of Fushiwara, a family which seems to have risen to empire through the overthrow of Sagateno's lineal descendant and heir Shidzuta[21]. Other inscriptions present him as the King of the Raba-Kita, while Shidzuta was over the Yoba-Khita.

The inscriptions indicate that Budhism reigned in the Yenisei country, but not undisputedly, and this is in complete accord with the Japanese annals for the times of Sagateno and his successors. Amida is a Japanese surname of Budha, but the word has no significance; it seems foreign. The Anota of Inscription XVIII is most likely the Japanese *ando*, ease, happiness, tranquillity, denoting the state of the great teacher, who, having attained Nirvana, had become free from the evils of sentient existence. The time of Budha's attainment of Nirvana, or, as the inscriptions bluntly put it, of his death, I have decided, on the grounds of

many data furnished by Indian Budhist documents as compared among themselves and with western history, to have been 477 B.C.; so that the discipleship of Sagota in the year 970 from the death of Budha, fell in the year 493 A.D., when Thedoric the Ostrogoth became master of Italy. There is, so far, no evidence that Siberian civilization was older than the fifth century, and the last dated inscription was written in 784, so that two and a half centuries, or perhaps less, may be allotted to Khitan empire on the Yenisei. Thenceforward it was transferred to China, Corea, and Japan. But feeble remnants of the old Khitan stock still roam as semi-savages over the Siberian plains, the Yeniseian Khits in the neighbourhood of their ancestral glories, the Yukahirians, Koriaks, Tchuktchis, and Kamtschadales, farther to the east. The Mantchu, the Mongol, and the Yakut Turk occupied the country which the civilized Khitan deserted, and to them, the mounds that remain almost the sole records of a busy life twelve centuries in the past, are Li Katei, the tombs of the Khitan[22].

Sagota assembled all classes of his people, the poor and the rich, to aid in rebuilding the ruined Round House. This is far from the only instance which the Siberian inscriptions afford of the ascendency gained by the Budhist priesthood over the Khitan monarchs of northern Asia, and the consequent recognition of their creed as the religion of the State. At the same time, in order that the time and labour given by the people to the service of Budhism might not appear to be accepted without remuneration, the priests granted, by order of Budha, whose oracles they thus claim to have been, an indulgence extending over the space of three hundred years. This would carry through several generations of ordinary sinners, but the lives of Budhist offenders, whose trans-migrations extend over thousands of years, would not be so largely affected by it. It would be curious to trace the connection between the indulgences of the Budhists and those of the Roman Catholic Church. The latter came into notice in the twelfth century in connection with the Crusades, and with the publication of Peter Lombard's text book of Theology. Prior to that time, there was no intercourse between northern Asia and Europe of an ecclesiastical nature, beyond the mission of Prester John; but, in the thirteenth century, Christian missionaries from Rome found their way into the countries ruled by the Mongols. No inscription so far read shews that the Indian Budhists granted such indulgences, but it is very improbable that the system originated in Siberia, a region in which there can have been little original development, on account of adverse changing conditions that must have made it difficult even to retain and perpetuate the existing rites of the Budhist religion. The position of Budha in Siberia is very plain and definite. He was no longer the

preacher of peace, the reprover of idolatry, the friend of humanity, and the moral reformer, but supreme god, possessing omniscience and the power to punish or to forgive sins. The Indian Sidhartta's creed was so far atheistic that it asserted the humanity of the Brahman gods, and maintained the possibility of any man attaining godhead or Budhaship by the patient accumulation of merit. This the Khitan, like the Thibetans and Budhists all the world over, failed to perceive. The instinct of worship was strong in them, and, knowing no higher name than that of Budha, to it they made their supplications and looked for future rest, when death should transfer them from the Siberian land to another state of existence.

One cannot love the Budhist priests of the Yenisei. They were greedy, vain-glorious, quarrelsome, and vindictive. Their master Gotama was to them a mere commodity for buying and selling and getting gain. To them, kings and queens were simply stalking horses, under cover of which they brought work to the buildings that sheltered their lazy bodies, and money into their coffers. Individual Budhists performed noble deeds of self-sacrifice, but not a single good action worthy of notice is recorded of a Budhist priest. Yet these wretches were the repositories of learning. They were scribes and engravers, and, had it not been for them, the history of Siberia might have been a total blank. Happily, the Japanese annals enable the student of history to read between the lines they laboriously carved, and inspire him with a measure of respect for the royal personages of Asia's northern kingdom, whom they valued simply as the means of their own support. Budha as a deity is naught, but, save for Budha, the world would not know ancient Siberia. Still, the more I consider the evidence which history presents, the more convinced I am that, in spite of its degradation and the moral worthlessness of its ministers, Budhism was the salvation of the Khitan. It furnished to all who gave heed to the better impulses within them, and, who, under more favourable conditions, might have become poets, artists, or philosophers, a moral ideal, which, entering into their lives, became a standing protest against devotion to mere material prosperity, against the letting loose of angry passions in strife and bloodshed, and against the utter abandonment of self to sensual indulgence characteristic of the votaries of heathen religions. The savour of the salt may not have been of the best, but the salt was there. China was not unaffected by it; Japan, and even Corea, are evidences of its preserving power. It crossed the northern Pacific and found a sphere for its valuable properties in America, which is not deficient in Budhist, and even in Budhist dated, tablets; but, as Rudyard Kipling says, "that is another story."

NOTES.

[1] Inscriptions de l'Ienissei, recueillies et publiées par la Société Finlandaise d' Archæologie, Helsingfors, Imprimerie de la Société de Littérature finnoise, 1889.

[2] Inscrip. de l'Iénissei, p. 3.

[3] Strahlenberg, Das Nord und Östliche Theil von Europa und Asia, 1730.

[4] The bronze fragment is in The Hittite Track in the East, and appears to have been a traveller's passport.

[5] Some of these are represented in Inscriptions de l'Iénissei; others in Spassky's article on Siberian Antiquities in the XIIth volume of Transactions of the Imperial Society of Geography of St. Petersburg, 1857; and the Hittite Track in the East compares them with American sculptures.

[6] Pallas, vol. IV.

[7] The Hittites in Sinai, dealing with these inscriptions, is ready for the press.

[8] Sufficient attention has not been paid to the Khitan, who figure largely in the history of Northern Asia. They will be fully treated of in The Hittite Track in the East.

[9] See my treatises on The Hittites, their Inscriptions and their History: Etruria Capta, Trans. Canad. Inst.; Monumental evidence of an Iberian population of the British Islands, Trans. Celtic Soc'y. of Montreal: also The Eastern Track of the Hittites, The Hittites in Sina i and the Western Hittites, in preparation.

[10] See Plate I.

[11] See The Hittites, I. 38, and Plate, Ierabis III.

[12] Analysis of No. XX.

Part I, line 1. *Mekuba*, proper name feminine, Japanese Mikifito.

tobai, archaic form, composed of *to*, company, and *bai*, now *hai*, united to, as in *hai-suru*, to mate, join together. In some Japanese dialects, especially in the older language of the Loo Choo Islands, initial *h* is pronounced *f*, indicating that the initial aspirate is the corruption of an ancient labial. Of this there are many illustrations. A modern word for "companion" is *hobai*, from *ho*, a side, and *hai* or *bai*, joined to.

mito is not in modern use, but is the same word as

mi-kado, king or emperor, literally the sublime porte, from *mi*, honourable, and *kado*, a door; but *to* designates a door as well as *kado*, and is a much simpler and older term.

Metome, proper name, masculine, better Mi-tomo, the honourable companion, and thus the same as the Otomo of Japanese history.

iku, now *ikeru*, to bury, put in the ground. The final *ru*, *ri* of many Japanese verbs is the verb *aru*, *ari*, to be, and does not affect the primitive root.

Mekuba, see first word.

line 2. *kado*, Jap. door.

mi, " imperat. of *miru*, to see, behold.
toji, " adj. form of *toji-ru*, to close, shut.
tachi, " to stand.
abatta, " pret. of *abai*, to protect, defend.
ba, " conditional or potential suffix.

imi doku, "composed of *imi*, to hate, and *doku*, harm, injury, literally, the poison of malice.

buji, " safe, free from accident.

tsuka, " a tomb.

line 3. *Sagota*, proper name masculine, Japanese Sagateno, and Chinese Sheketang. In India, Sangata or Sankata.

Yobakame, also called in other inscriptions Yoba-Kita, the name of a people. As their ancestor Yoba was a deity after whom the river Obi was named, it is possible that the form is Yoba-kami or the divine Yoba.

chiji-ta-shita, composed of *chiji*, a governor and *shita*, inferior, subordinate; the copula *ta* is probably the relative, the governor who (is) inferior.

mo, Jap. even.

Shidzuta, proper name masculine, in other inscriptions, simply Dzuta; compare Chinese Chuh-te.

line 4. *Raba*, the name of one of the tribes of the Kita.

mame, in Indo-Hittite *mema*, old word for people, root of the present bam-*min*, jim-*min*, people.

Buda, in Jap. Butsu. The use of a circle to denote Budha arises from the fact that his epithet *go-tama* the great master, also means, the great ball.

bai, see line 1, *to-bai*.

to, Jap. company.

gukumomi, now *gakumon*, learning, literature, science.

line 5. *keiku*, or *keigo*, Jap. a guard.

kudatta, Jap. pret. of *kudashi*, to send down, yield.

Part II, line 1. *ta*, Jap. who.

giri, " right, rightness,

ga, " genitive particle.

fuju, " scarce; better *fusoku*, deficient, wanting in.

line 2. *toji*, " see Part I, line 2.

tsuka, " ibid.

sai-do, " a second time, over again.

tojiku, old word meaning to unclose, now *toki*, *toku*, undo, rip open.

line 3. *yame*, Jap. *yamome*, widow; might be called *yome*, but that is the Indo-Hittite word for daughter.

tobai, see Part I, line 1.

mio Sagota, see Part I, lines 1 and 3.

tsugi, Jap. *ato-tsugi*, heir, successor.

line 4. *mito Shidzuta* see part I, lines 1 and 3.

kubiri, Jap. to choke, strangle, hang by the neck, but *kubikiri*, to behead; *kuberu*, put in the fire.

beku, Jap. particle should, ought.

de, " negative particle.

[18] Analysis of No. XVIII.

Line 1. *tattobi*, *tattobu*, Jap. to honor, reverence.

Buda, see No. XX.

Anota, epithet of Budha ; see text.

kogo-ino : ino is an old noun meaning prayer, whence the modern verb *ino-ri*, to pray, and its substantive *inori* ; *kogo* or *koku* is probably a form of *koi*, to request.

ji, Jap. a Budhist temple.

bei or *bai*, see No. XX, Part I, lines 1 and 4.

mito Sagota, see No. XX.

maru, Jap. a circle ; but *marui*, *maruki*, round.

taku, " a house, building.

mado, " *motoi*, foundation.

tsubeshita, " pret. of *tsubushi*, to break, destroy.

line 2. *Sagota*, see above.

no, Jap. genitive particle.

kami, " superior, ruler, lord.

tobai, see above.

fu, Jap. *ho*, law, doctrine, anciently *fo*.

deshi, " disciple, scholar, pupil.

tai, " to desire, wish.

kudaki, " to break to pieces ; but *kudake-ru*, broken, shivered.

beri, " *heri*, loss, waste, ruin.

ato-tadzu, " *ato-wo-tate-ru*, to raise up the ruins ; the *wo* is not essential.

line 3. *Buda-Anota* see above.

hiromeku, Jap. to proclaim, common in Indo-Hittite.

tadasha, " *tadashii*, upright, just.

mito Sagota, see above.

yobidata, Jap. pret. of *yobidasu*, to call out, summon.

himku, " *hinku*, poor.

omaka-dzu, " *omaka-na*, magnanimous, generous, liberal.

line 4. *ta*, Jap. who.

gohiyo, " *ko*, little, and *hiyo*, day's labour

shigo, old verb, to work, now only used as the noun *shigoto*, work.

ne, Jap. future suffix.

ri, denotes a Japanese mile anciently consisting of 50 *matsi*, each *matsi* containing 60 *ken* ; thus a *ri* was 3000 *ken*. But, in Indo-Hittite and Siberian, the term *ri*, employed to measure time, designated 300. Of this there is abundant proof in the Eastern Track of the Hittites.

toshi, Jap. year.

ga, " genitive particle.

gashita, " *gasshi*, to join together, unite.

jigo, " deeds.

mihadzu, Jap. *mihadzu-shi*, to overlook.

yaku, probably same root as *uke-ai*, to promise, guarantee, but better as the verbal form of *yaku*, a promise.

Buda, see above.

line 5. *deshita*, old verbal form from *deshi*, a disciple, now *deshi-iri*, to become a disciple.

Sagota, see above.

ari, Jap. verb, to be.

mo, " even.

kokonote, Jap. *kokonotsu*, 9.

mo, Jap. *momochi*, 100, a common abbreviation.

futa, " *hatachi*, 20, but 2 is *futatsu*.

to " *towo*, 10.

shi " death.

go " after.

line 6. *mite* " *imperat*, of *mi ru*, to see.

matoku, Jap. *mattoku*, to consent, approve, concur in.

wabi, Jap. *wa*, peace.

do, Jap. road, way, path.

ri dzume, Jap. convinced by reason, a common Budhist formula.

[14] Anal. of No. XVII, line 10.

shu, Jap. lord, master.

Buda, see above.

to, Jap. company.

taku, Jap. house.

no, Jap. genitive particle.

dansaku, Jap. *dan*, a step, raised platform, and *saku*, an author.
Shibata, Jap. proper name masculine *Seiwateno*.

[15] As most accessible, see Encyc. Brit. art. China.

[16] For these, and other Chinese references, see Gutzlaff's Sketch of Chinese History.

[17] San Kokf Tsu Ran To Sets.

[18] Titsingh, Annales des Empereurs du Japan, 97, seq.

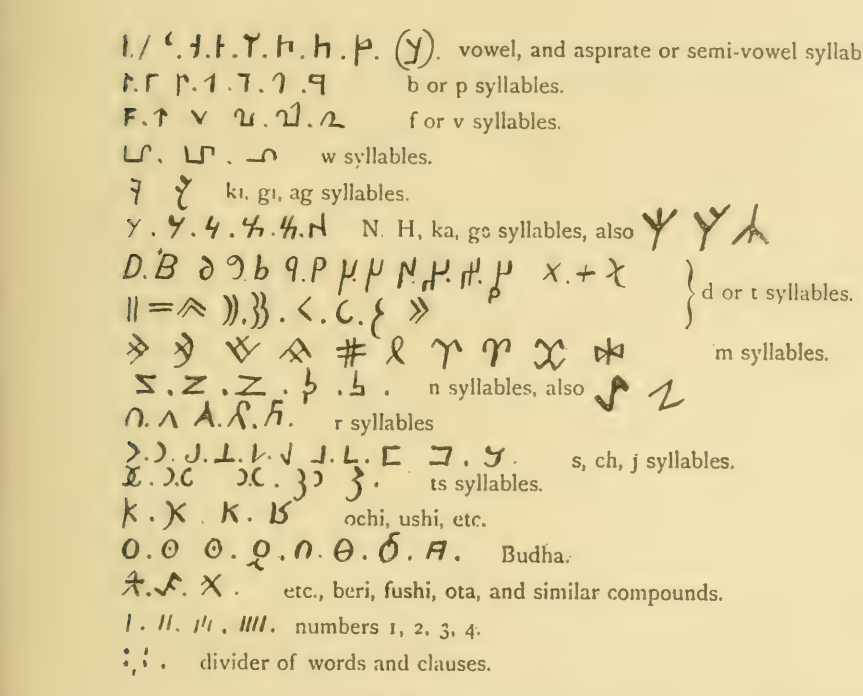
[19] Titsingh, 82.

[20] Titsingh, 109.

[21] Titsingh, 115.

[22] Malte Brun, Geography in loc.

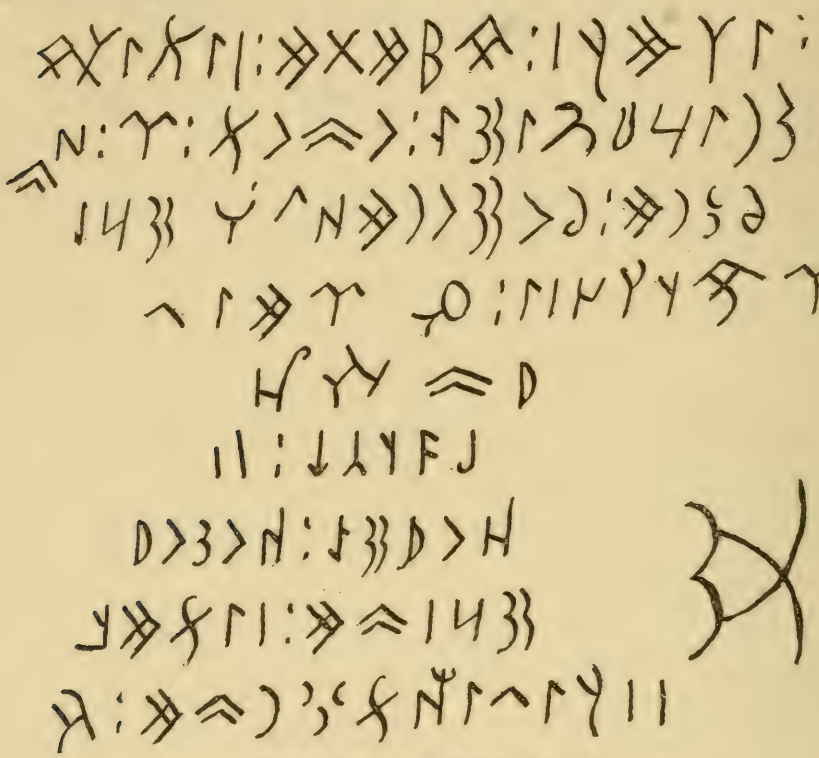
Plate I.—The Siberian Characters and their Consonantal Values.



The direction of the writing may generally be ascertained from the commoner m syllable, which faces thus. It appears that is a *be, pi* form, and , a *ba, po* form , is *mi*, and is *ma*, that is *shi*, and *sa*; while is *fu*, and is *ki*. is an *f* syllable, and a *w*, is *ko*, and is *to*; is *yo*, and is *ka*; is *chi*, and is *te*. The direction of the characters is thus of as much importance as the form. Abnormal forms can easily be classed among those here given by their leading characteristic and direction. It will yet be possible to assign specific vowel values to the vowel and aspirate, labial, guttural, dental, and sibilant characters, including *m*; but the *r*, *n*, *ts*, and *ochi* syllabic characters have no vowel differentiation. Some of the characters in the table on the page entitled, Types dans les inscriptions, in Inscriptions de l'Ienissei, are misleading, having been read as inverted perpendicularly or laterally, such are , etc.

PLATE II.

M. Youferoff's copy of No. XX. in Inscriptions d'Ienissei, in large, clear-cut characters from ¾ to 1 inch in length.



INSCRIPTIONS DE L'IENISSEI No. XX.

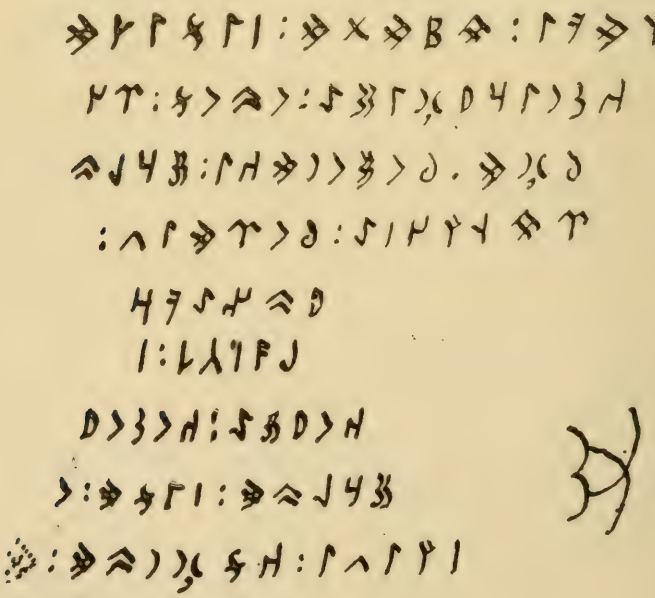
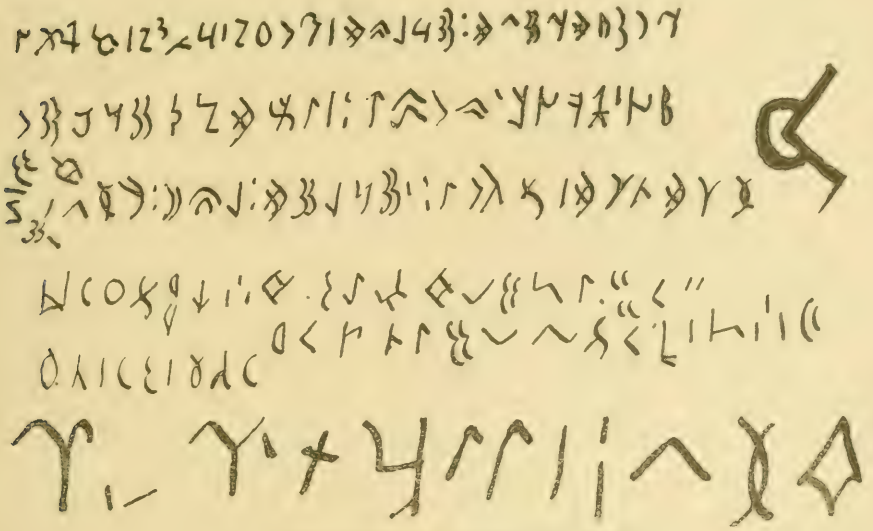
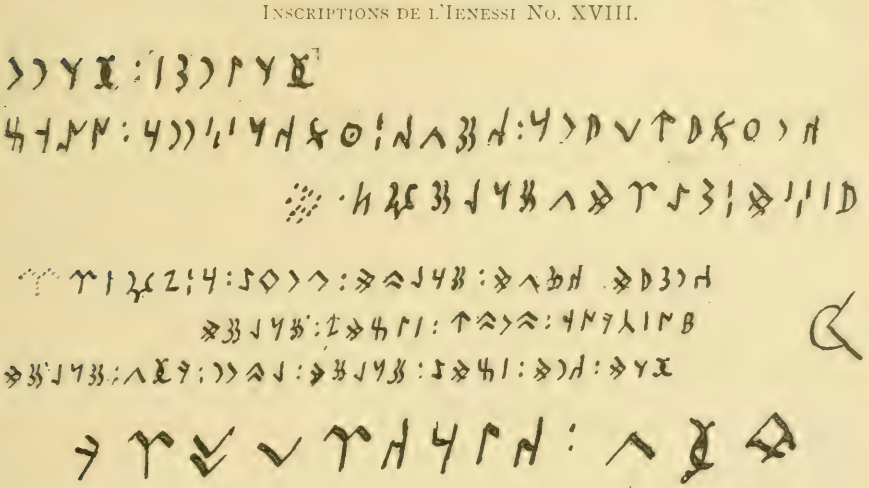


PLATE III.

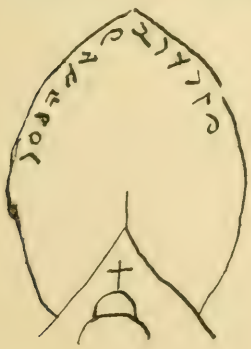
Mr. Youferoft's copy of No. XVIII. in Inscriptions de l'Ienissei, like the foregoing.



INSCRIPTIONS DE L'IENESSI NO. XVIII.



Part 10 of No. XVII. Inscriptions de l'Ienissei, and the same according to Mr. Youferoft.



THE ADMINISTRATION OF LIEUT.-GOVERNOR SIMCOE, VIEWED IN HIS OFFICIAL CORRESPONDENCE.

By Ernest Cruikshank.

(Read 28th March, 1891.)

Until very recently the materials for the history of the Province of Upper Canada under the administration of Lieut.-Governor Simcoe and his immediate successors, accessible to the inquirer, were scanty indeed. Portions of some of Simcoe's earlier despatches had, it is true, been copied many years ago for the Library of Parliament but their fragmentary condition rendered them of little value. The entire correspondence has now fortunately been transcribed under the superintendence of the able Dominion Archivist and may be consulted by anybody sufficiently interested in it to take that trouble. It may be said, without exaggeration, to throw a flood of light not only on the domestic affairs of the Province but also upon the relations of Great Britain with the United States, and with the Indian tribes of the west during a most critical period, and even upon the conduct and progress of the war which was then being carried on by the United States against those tribes.

I simply intend in this paper to refer to those parts of the correspondence which relate to the internal affairs of the Province. Simcoe was undoubtedly a man of an active and original turn of mind, a forcible and voluminous writer of despatches and even when his projects came to nothing, they seldom fail to be interesting and ingenious. From the start, he based great hopes of the rapid development of the colony upon the labors of the small military force which he brought with him. In memorials addressed to Lord Grenville and Mr. Dundas shortly after his appointment in 1791, he described his intention of building barracks, grist and saw-mills near the head of navigation on the principal rivers falling into Lakes Erie and Huron; when this was accomplished, the soldiers would be engaged in opening roads and building bridges. The barracks were then to be converted into public houses to be let by auction and the licensing of all others prohibited by Act of Legislature. The mills would be rented in a similar manner. By this means he anticipated that a considerable revenue would be obtained and the colonists enabled to devote their whole time to the cultivation of the soil. The soldiers would then be employed in the navigation of the

king's ships upon the lakes. The battalion raised for this service was to consist of four companies of one hundred rank and file each, with the usual staff and an auxiliary detachment of military artificers. The officers were selected without exception from the half-pay list of Simcoe's disbanded corps, the Queen's Rangers, or 1st American Regiment, so justly celebrated during the revolution. A subsistence state for 1792 shows that the actual strength of the battalion at the date of its arrival in Canada was fifteen officers and 416 N. C. O. and privates.

The Reverend Samuel Peters, a distinguished loyalist exile, and the author of a quaint history of Connecticut, well worth reading even now, was recommended for the episcopate of the new Province, and it was suggested that his influence might be used to attract many colonists from the former scene of his labors, which was thought to be overpopulated.

Five subjects were designated by Simcoe as deserving the special attention of the settlers. These were the cultivation of flax and hemp; supplying the Indians with rum distilled from parsnips; discovering the best situation for iron forges; the manufacture of salt from the salt springs; and lastly, that in founding villages, they should select sites capable of defence by a few men against numbers, particularly in places where they were exposed to "an attack by Indians or North Americans."

The new Lieutenant-Governor arrived at Quebec early in November, 1791, but in consequence of a legal opinion delivered by Chief Justice Smith, that the presence of a majority of his executive council would be necessary to enable him to lawfully assume the administration of the Province, he determined to await the arrival from England of Chief Justice Osgoode and Mr. Peter Russell before proceeding to Upper Canada. Although they were daily expected, he was actually detained in this manner until the following June, when they finally reached Quebec and accompanied him westward. He employed these months of enforced inaction in making himself familiar, as far as lay in his power, with the geography and resources of his government, about which very little was known even there, except what could be gathered from the mouths of hunters or traders. The letters written by him during this period contain a variety of interesting information. A recent survey of the Thames led him to anticipate that that river would furnish an easy route from the head of Lake Ontario to Lake Huron, which would supersede for all military purposes, the ordinary channel by way of the Niagara and Lake Erie. Even then he foretold the future commercial greatness of Toronto. The discovery of an unimportant salt-spring on the river Trent filled him with hopes that the manufacture of salt might

become the source of considerable revenue to the Province, as he noted the fact that salt smuggled from "licks" in the United States was selling for as much as £5, New York currency, per bushel.

He endeavoured to conciliate Sir John Johnson, who was believed to be discontented because he had not been appointed Lieutenant-Governor of Upper Canada himself, and whose influence for the election of members of the Assembly it was deemed of great importance to secure. Sir John complained that after having been requested to furnish a list of the "principal characters" in the western settlements to be recommended for seats in the Legislative and Executive Councils, an ill-advised and partial selection had been made, and most of those distinguished in the Revolution had been passed over. Consequently he declined to offer any further advice. He still continued to hold the important office of Superintendent of Indian Affairs, being responsible to the Governor-General alone, and any serious quarrel with him might have very embarrassing results.

Simcoe lost no time for paving the way for immigration from various parts of the United States. In one of his earliest despatches he relates that a correspondent in Pennsylvania had informed him that a great number of people in that State were disposed to remove into Upper Canada, and others in Connecticut had assured him that the appointment of Mr. Peters as Bishop would have the effect of attracting many from that quarter, although he remarked that the delay which had already occurred in granting a free constitution to the Province had altered the views of many loyalists there. Hearing that many Quakers intended to emigrate from the Eastern States, he decided to send a confidential agent to confer with them on matters which they were too cautious to commit to paper, in the hope of inducing them to come to Canada also. Early in the spring of 1792, he caused a proclamation to be published in English and French announcing that free grants of land would be made to all persons desirous of settling in the Upper Province, one-seventh of the land being reserved for the support of a Protestant clergy, and one-seventh for the use of the Crown. The settlers would be merely required to subscribe a declaration that they would defend the "authority of the king in Parliament." Not more than 200 acres would be granted in the first instance to any one person, but the Government might subsequently grant an additional tract not exceeding a thousand acres. He requested Mr. Dundas to have this proclamation sent to the West Indian papers for publication, believing this to be the surest means of scattering it widely in the United States, as he felt satisfied that the land speculators, if not the Government itself would endeavour to prevent it from passing the northern frontier.

The negotiations concerning the boundary question then pending with the United States naturally engaged much of his attention, more particularly as he had been instructed to furnish Mr. George Hammond the British Envoy at Philadelphia with all the information on the subject he could obtain. The menacing movements of successive American armies beyond the Ohio caused him great uneasiness as it was feared, probably with some truth, that their ultimate aim was the capture of the British garrisons on the great lakes.

One of his first measures was to advise the purchase of a tract of land extending across the Georgian Bay peninsula from Sturgeon Bay to be used as a camping-place by the traders frequenting that part of the country. A map accompanying his letter to Mr. Dundas of the 10th March, 1792, indicates that the Indian title had been already extinguished in the lands included between the Ottawa, Rideau, and St. Lawrence; in a second tract extending from the Bay of Quinte westward, bounded on the north by the chain of smaller lakes and on the west by a line drawn from Lake Simcoe to Lake Ontario, near Toronto, and lastly in all that part of the Province lying south of a line extending from the head of Lake Ontario, to the supposed source of the river Thames and then following that river to its mouth excepting a small Huron reservation on the Detroit, and Brant's grant of 306,250 acres on the Grand. The lands of the Six Nations had been surveyed and the new Governor had assured them solemnly of his intentions of carrying into effect all Lord Dorchester's promises to them, but he remarked in this despatch that it was particularly unfortunate that one of the first acts of his civil administration must be the trial of two Indians closely related to Brant himself on a charge of murder.

The progress of negotiations with the United States was delayed not only by hostilities with the Indians but by rival commercial interests. Three great fur-trading houses of Montreal warmly protested against the surrender of the four barrier forts of Oswego, Niagara, Detroit, and Mackinac and the concession of the Great Carrying-Place at Sault Ste Marie, which would lie fifteen miles within the proposed boundary line of the United States. Their chief trade-route would be then placed in the hands of their rivals and their trade, they averred, must be ruined in consequence. The annual value of their transactions was estimated by themselves at £200,000 and a demand was thus created for a large quantity of bulky British manufactures, upon which the duty alone sometimes exceeded £30,000 in a single year. Although sympathizing with the views of the merchants on the boundary question and backing up their protest against the advanced position already assumed by

some American officials that they had a right to prohibit all British traders from even entering the territory of Indian tribes within the United States, Simcoe wisely remarked that the fur-trade was of minor importance to the Province under his administration and he was quite willing that the northwest traffic should remain in the hands of these well-established companies, while he would be content with encouraging the Indians of the locality to bring their peltry to the nearest settlements. Yet he indulged in visions of the time when British manufactures would find their way in this manner even beyond the Mississippi and in the much wilder hope that the independence of the Indian nations would be secured forever in consequence, and they would form a bulwark against aggression for his Colony.

His mind was forever occupied with fresh schemes for the benefit of the inhabitants. He immediately observed the great inconvenience arising from the scarcity of small coin. The farmers had no other means of obtaining necessaries than by bartering their produce to the local merchants who were accordingly enabled to fix their own prices both on the articles sold and those taken in exchange for them. The cost of manufactured goods rose progressively as they were sent westward and at Detroit they sold for fully fifty per cent more than in Montreal. In anticipation of this want the Governor had requested before leaving England that a considerable quantity of copper coin should be issued to the troops annually and he now asked that £500 in sixpences should be added.

The subject of higher education also engaged his attention as a question of great importance, since he foresaw that if provision was not soon made for educating their children within the Province the wealthier inhabitants would be tempted to send them to schools in the United States where he feared they would become imbued with improper opinions. For the present he thought that primary education might be left in the hands of parents and relatives, but he recommended an annual grant from the British Treasury of £1,000 for buildings and salaries, and the establishment of a teacher of classics at Kingston and another at Niagara with a salary of £100 each, and the foundation later on of an university at the capital with a full staff of professors, all of whom should be clergymen of the church of England except the Lecturer in medicine.

Besides Toronto, he pointed out the sites of London, Chatham, and Port Dover, as suitable places for the foundation of towns and at first he favored London as the spot for the capital, chiefly however, for the purpose of confirming British influence over the Indian tribes of the West by the presence of a strong garrison.

His more ambitious projects as a rule met with scant favour at the

Colonial Office. Even in respect to his efforts for encouraging immigration, Dundas felt it expedient to cool his zeal by observing: "I am not of the opinion that such emigration would be producive of all the good results your mind would suggest. Population is often the effect but never the cause of prosperity, especially in an ingrafted population outrunning all laws, regulations, usages, and customs which govern us and go hand in hand with a progressive and well regulated population. I have said this not to check emigration from the United States but because there is every appearance of sufficient numbers coming of their own accord without going out of your way to entice or allure them. If care be taken to render the situations settled under your care comfortable, their fame will naturally spread and attract a sufficient emigration. Nothing can be more justly offensive to other nations especially the neighboring States than to make the emigration of their subjects a proposed and avowed object of our Government." "As to the establishment of schools and an University he added, "I believe only the first will be necessary for some time to come."

One of Simcoe's first executive measures upon assuming the functions of Governor was to continue in force the courts of justice as they had been previously established. Two men who had recently arrived in the Eastern District from the United States had been arrested for uttering seditious speeches, but although their guilt was amply proven they were discharged with a reprimand.

On the 20th August, 1792, a few days after his arrival at Niagara where he was warmly welcomed by the inhabitants, the Governor exultingly informed Mr. Dundas that there was every prospect of a very great influx of immigrants from the United States and that he had in consequence promised the same exemptions to the Quakers and kindred sects that they had always enjoyed under the British Government. About fifty families of reputed Loyalists had also been sent out from England through the agency of the Rev'd Mr. Peters. They arrived at Kingston about the beginning of October and were at once settled on farms in the vicinity. It was however soon discovered that a number of them had in point of fact never been in America before.

The battalion of Queen's Rangers was quartered for the winter in huts at the "new landing" on the Niagara which then received the name of Queenston in consequence, and the Governor announced that he intended to establish military posts at Long Point and Toronto early next spring and "to set myself down on the la Tranche."

In his despatch of the 4th of November, enclosing the journals of the

first session of parliament, he commented at some length on the composition and proceedings of the two houses. He had been told on his way up the St. Lawrence that there was a strong prejudice against the election of half-pay officers, and that the popular feeling ran in favor of men of less pretensions who ate at the same table with their servants when they had any. Yet a fair proportion of the former class, such as McDonell, Pawling, and Elliott had actually been chosen and as a whole he described the House of Assembly as being composed of the "most active characters in their several counties." "Many of the members" he added, "were not averse to parliamentary wages," and a bill was passed through the lower house imposing a duty of six pence on the gallon of rum and spirits passing through the province which it was anticipated would yield a revenue of £1,500 per annum. This bill was warmly opposed in the Legislative Council where the large merchants were predominant, on the ground that nearly the whole of these goods belonged to Montreal houses, and it was summarily rejected. The smallest tax on real estate was hotly resisted on the pretext that it would discourage immigration, but probably the real reason for the opposition lay in the fact that a majority of members of both houses were already large proprietors.

A bill to validate the irregular marriages which had been contracted throughout the province prior to its organization was also introduced into the Legislative Council by the Hon. Richard Cartwright, who soon gained the Governor's ill-will by a more or less pronounced opposition to several government measures, and it was only withdrawn on a definite pledge that the Attorney-General would frame a satisfactory Act and send it to England for the approval of the law-officers of the Crown. The House of Assembly exhibited a much stronger feeling in favor of adopting the "elective principle" in municipal affairs than Simcoe considered advisable, and he exerted his influence successfully to secure the postponement of a measure which was introduced providing for the election of all township officers by a popular vote. In order to counteract the spirit of democracy and "to promote an aristocracy most necessary in this country" he hastily appointed lieutenants for the most populous counties and invested them with the same recommendatory powers with reference to the selection of magistrates and officers of militia which were exercised by similar officials in England, but this attempt at transplanting aristocratic institutions did not meet with the approval of the British Cabinet, as it was thought that it would have a tendency to diminish the authority of the Lieutenant-Governor, and Simcoe accordingly promised to make no further appointments of that kind, and when these offices became vacant they were not again filled.

Other subjects which had attracted the Governor's attention and which he then brought to the notice of the Colonial Office were the increase of his regiment by two companies to enable him to man the public vessels on the lakes, the establishment of a port for the province to render it independent of the merchants of Lower Canada, and he suggested that communication with the ocean by way of the Mississippi would be of vast importance. Owing to the critical state of relations with the United States he requested that a small field-train of artillery and a detachment of military artificers should be sent to the province. French refugees might, he thought, be settled with advantage near Detroit, where the French Canadian population already possessed representatives of their own race and religion in the Assembly and Legislative and Executive Councils. He inquired whether the affirmation of a Quaker could be taken in place of the customary oath to enable him to sit in the Legislature. He reiterated that encouragement must be given to clergymen of the Church of England as the inhabitants were chiefly dissenters and were already sending to the United States for ministers.

When reporting the proceedings of the second session of parliament, he observed that there did not seem to be any organized opposition to Government measures, at least in the Assembly, but that in the Legislative Council Messrs. Cartwright and Hamilton usually acted in concert and assumed an attitude of defiance and even hostility which plainly excited his keen displeasure. Hamilton, he asserted, was an open and avowed republican.

By this time the demand for a marriage law had become much stronger and more general, and as there were very few members of the Church of England in either house there was a disposition to make the ceremony of marriage much less formal and solemn than the Governor desired. In fact the Assembly tacked an amendment to the government bill after it had been passed by the Legislative Council which gave clergymen of every sect and denomination authority to perform the rite. This was however withdrawn upon an assurance being given that the Government would introduce another and more liberal bill.

The main interest of the session centered on the act abolishing slavery which met with keen opposition. Some persons having purchased negroes at low prices from the Indians during the Revolution wished to secure its rejection entirely. Others who wanted to supply themselves with slaves in the future were anxious to have it modified in such a manner as to permit their importation to continue for at least two years

longer. As usual the antagonists of the act of emancipation dwelt upon the cost and difficulty of obtaining free labour.

A minute in the proceedings of the Executive Council shows that on occasions the slave-owners did not hesitate to defy and thwart the law in the most insolent manner. "On the 21st March, 1793, Peter Martin, a negro in the service of Col. Butler, attended for the purpose of informing the Council of the outrage perpetrated on Chloe Cooley, a negro girl in his service by one Fromand (Vrooman?) of Queenston by binding her and delivering her to certain persons unknown, against her will. The evidence of William Grisley or Crisley was taken, that she was tied, and delivered as above stated, and that he saw a negro at a distance also tied, and he had heard that many other people mean to do the same by their negroes; and it was resolved that it is necessary to take measures to prevent breaches of the peace and the Attorney-General was instructed to prosecute Fromand."

A scarcely less important measure, passed at this session, was the first municipal act. The Governor had by this time convinced himself that to place the nomination of township officers entirely in the hands of the magistrates as he had at first been inclined to do, would be extremely unpopular and the great mass of the Loyalists were decidedly of the opinion that these officers and particularly the collectors of rates would be more readily obeyed if they were elected by the ratepayers, and an act was passed accordingly under which clerk, assessor, collector, wardens &c., were all to be elected annually at a town-meeting held for the purpose.

The bill for imposing a duty on spirits in transit through the province was again passed by the Assembly and defeated with much difficulty in the other house, as its advocates hoped that it would provide a fund for all purposes and leave a sufficient balance in the Treasury for the payment of members' wages. It was then agreed that a system of district assessments should be adopted for all local improvements, by levying a rate upon all real and personal property, and as a majority of members still insisted upon securing salaries, a special rate was imposed on each riding for this purpose. Although the sessional allowance was fixed at only two dollars a day, this act caused considerable dissatisfaction among their constituents. At the close of the session the Provincial Treasury was empty and the Assembly was in consequence obliged to pass a resolution asking the Governor for a loan to pay salaries and contingent expenses to be repaid at the next session and the sum of £191 5s. was accordingly advanced by him. The British Parliament had already voted £6700 to meet all other expenses of the civil government of the province.

During the summer, surveys of the river Thames and the harbours of Toronto and Long Point were completed. Simcoe still intended to fix the capital at the place on which he had bestowed the name of New London and to remove the naval stations from Detroit and Kingston to those new ports as soon as possible. He also settled all doubts as to the ownership of the lands bordering on Lake Erie by a new treaty with the Mississauga Indians. He then urged that the regiments stationed in the barrier forts should be at once completed to their full strength to enable him to occupy all three points with a sufficient garrison, but Lord Dorchester peremptorily declined to comply with this request.

The road from the head of Lake Ontario to Oxford where boat navigation of the Thames began had been got well under way by the Queen's Rangers and the headquarters of the battalion, owing to the unhealthy state of the cantonments at Queenston, was removed to Toronto where a barracks and blockhouse were commenced.

In October Simcoe personally explored the trail from Lake Ontario to Lake Huron and visited the newly discovered harbor of Penetanguishene with which he was delighted.

The prevalence of sickness in the Genesee country checked immigration into the province from the United States, although numbers still continued to come in, and the Governor recorded with pleasure the arrival of a party of loyalists from North Carolina who first learned that the King still had possessions in North America after reaching the Genesee.

Seemingly interminable negotiations with the United States and the Western Indians consumed much of his time, and a singular and embarrassing divergence of opinion on almost every conceivable subject became apparent in his correspondence with Lord Dorchester, who still exercised supreme authority in military affairs and all matters connected with the Indian department.

In a despatch dated in February, 1794, Simcoe briefly described the condition of the western part of his province. On the Bay of Quinte, there was a flourishing and populous settlement of Loyalists. Thence westward to Toronto, the north shore of Lake Ontario had scarcely begun to be inhabited and a strip of thirty-six miles of Indian lands separated the small new colony at York from Burlington Bay when the Niagara settlement began. The latter he styled the "bulwark of Upper Canada." As yet no lands had been granted west of Fort Erie as he thought it prudent to occupy Long Point with troops before extending the settlement in that direction. At Detroit the principal settle-

ment lay outside the boundary but great efforts had been made to induce the inhabitants to remove into British territory though with only moderate success. Dundas Street, intended to connect the settlements on the Niagara with those on the Detroit and Lower Thames, was already half completed, and it was proposed to extend it at once to York and ultimately with the assistance of the inhabitants, to Kingston and Montreal.

Again and again he reverted to his favorite project of the establishment of a British factory on the west bank of the Mississippi, a measure which he was led to believe from his correspondence with the Baron Carondelet, (the Spanish Governor of Louisiana,) would be regarded with satisfaction by Spain.

During the session of 1794 one of the chief government measures was a Militia Act prompted by the continued precarious relations with the United States. A bill for the establishment of Superior Courts was vigorously opposed in the Legislative Council by Hamilton and Cartwright, all the other members supporting it. It was then passed through the Assembly without dissent and Simcoe related that it was with difficulty that that House was dissuaded from reading the bill a first, second, and third time on the same day, to mark their disapprobation of the opposition it had received in the Council.

A new assessment law was enacted which remedied some of the defects of the previous Act. Hitherto all persons rated below £50, being in fact a majority of the inhabitants, had been entirely exempted from taxation and the highest assessment of any individual had been fixed at £400. Under the new law every householder was taxed at least two shillings and those owning property to the value of more than £500 were to pay a rate of five shillings on the £100. It was hoped that the revenue would be at least doubled in consequence of these changes.

As the large surplus of grain for which no ready market could be found, had induced many of the inhabitants to set up private stills, a small license fee was also imposed upon these at this session.

The situation of affairs with the United States daily grew more threatening. A speech delivered by Lord Dorchester to a deputation of Indian chiefs was interpreted even by Simcoe as being ominously significant, and this was soon followed by instructions from the Governor-General to take vigorous measures to prevent General Wayne from seizing Detroit, which convinced him that war was believed inevitable.

Accordingly, early in the spring of 1794 Simcoe hurried to Detroit, mustered the militia into service, and armed them. Advancing with a

mixed force of regular troops and volunteers, he built and garrisoned a fort at the foot of the rapids of the Miami, a few miles above the site of the present city of Toledo, and occupied the island in the mouth of that river while he sent out gunboats to patrol the southern shore of Lake Erie.

A boat-load of stores ordered by Sir John Johnson from Albany for the use of the Indians was waylaid by a party of armed men while ascending the Mohawk River and plundered. Persons accused of giving information respecting the smuggling of salt into Canada were publicly whipped at Onondaga Lake. Philadelphia newspapers openly advocated the conquest of Canada and every sympathy was expressed for such of the inhabitants as were inclined to rebel against the Government. At the same time, agents from the French Republic were known to have entered the lower province with the same object.

Upon his return to Fort Niagara, Simcoe removed the greater part of the regular garrison to Fort Erie, mustered and armed about 400 Militia and an equal number of Indians, collected boats and provisions, and prepared artillery for a sudden and vigorous blow at the frontier posts on the Alleghany and Ohio as soon as hostilities began.* These active preparations for war occupied nearly the whole of the Governor's time and kept the province in a ferment of excitement and apprehension until late in the autumn when it became known, greatly to the relief of the inhabitants, that a treaty had been signed in London for the peaceful settlement of all matters in dispute. The expectation of a contest called forth a most enthusiastic and genuine expression of loyalty on all sides and Simcoe acknowledged frankly that he believed there was no one on whom more dependence could be placed, than that persistent opponent of Government measures, Mr. Cartwright.

* His scheme of operations was bold and well-planned. "Had Wayne besieged Fort Miami, I hoped to relieve it having made all preparations for that purpose. Had he been repulsed, the Indians would have regained their spirits, and joined by the Canadian militia and 200 British troops, would have destroyed his army. . . . . I should have known of these hostilities before the government of the United States. I should have, I had decided, surrounded Fort Le Boeuf, cut off Fort Franklin—they could not have held out an hour before my cannon. There would not have been an Indian of the Six Nations who would not have taken up arms. By small parties of white men as the mildest form of war, I would have burnt every mill on the Susquehanna to Northumberland or Sunbury, and on the Delaware to Minnesink, and in three weeks the whole of the Genesee would have been abandoned. There is not an Indian in North America who would not have flown to arms. The British Militia to a man on the first appearance of hostilities, have avowed the most determined loyalty. They are well calculated for offensive warfare. There are few families among them who cannot relate some barbarous murder or atrocious requisition on the part of the rulers of the United States. It is possible that the people near Pittsburg may have broke out into the late violences in the hope of Great Britain and the United States going to war." The recent disasters that had overwhelmed the armies of Harmar and St. Clair made the success of these operations quite probable.

During this time, Dundas Street was opened as far as the crossing of the Grand River, and Yonge Street was nearly completed to the Holland River. The banks of the Thames had also been settled with great rapidity by emigrants both from Detroit and Niagara. The water-route from Lake Simcoe to Matchedash Bay, and the harbor of Penetanguishene were surveyed and a considerable settlement formed at York and along Yonge Street.

Although the fur-trade of the west had suffered materially from the war between the Indian tribes and the United States, it continued still to be of considerable importance and was entirely in the hands of British merchants having their head quarters chiefly in Montreal, who also supplied the isolated French and Spanish settlements on the Illinois and Mississippi with manufactures. In the work of transportation through Upper Canada many hundreds of men were employed. Already they possessed a chain of trading posts extending along the Mississippi, from the Illinois to the mouth of the Missouri (then generally known as the St. Peter) which their agents frequently ascended almost to its source.

The winter of 1794-5 was spent by the Governor chiefly in superintending the construction of the military roads already commenced and the public buildings and a wharf at Toronto which was then formally designated as the future capital under the name of York. He requested that all moneys derived from the management of the Crown Lands should be applied for similar purposes and advised that these lands should not be sold but leased. Learning that some merchant vessels on the lakes were to be sold in the spring, he hastened to urge that they should be purchased by the province to prevent them falling into the hands of Americans. A block-house was built at Chatham as a preparatory step to the establishment of a dock-yard there. A satisfactory agreement was made with the Indians for the purchase of a tract of land at Penetanguishene whither he proposed to remove the garrison of Mackinac and part of the Lake Erie squadron, upon the evacuation of the "barrier forts."

When war with the United States seemed probable, a number of British half-pay officers living there had made arrangements to remove and join Simcoe's forces. When danger of hostilities no longer existed he proposed to settle these gentlemen and their followers on lands near Long Point, and to station a detachment of troops there, but as the latter was disapproved by Lord Dorchester, he was obliged to be satisfied with forming the settlement only, and encouraging the construction of saw and grist mills.

The parliamentary session of 1795 was uneventful. There was not a

shadow of opposition to any government measure. The rapid increase of population by immigration from the United States already rendered it necessary to pass a bill defining the qualifications of members of the Assembly. A petition was presented from the Presbyterians and other Nonconformists praying for the repeal of certain clauses in the Marriage Act and Judicature Bill which prevented their clergymen from performing the marriage ceremony. Means were taken to shelve the petition for the moment but Simcoe gloomily predicted that the matter would be seriously agitated. A Presbyterian minister had lately arrived from Scotland and dissenters of all denominations united to build a church for him at Niagara, while Mr. Addison, the clergyman of the Church of England remained without a church and almost without a congregation. Dissenters were also numerous in other parts and everywhere they were naturally inclined to protest against the unfairness of the law.

The public business had frequently been delayed by the absence of members of the Executive Council of whom no less than three lived at Detroit, and the Governor warmly complained that the salaries of all government officials were so small that none of them were able to live within their incomes.

In November, 1795, Lord Dorchester in his capacity of commander of the forces formally announced his intention of withdrawing the whole of the regular troops from Upper Canada with the exception of the four companies of Queen's Rangers and a small party of artillery-men which would be left to garrison two block-houses which he ordered to be built at Amherstburg and Niagara. This resolution, Simcoe regarded as dealing a death-blow to all his projects for the benefit of the province and strongly protested against it. The removal of the troops, he asserted, would destroy all confidence in British power among the Indians beyond the boundary, and render them presumptuous and troublesome neighbors to the new settlements. Already four whites had been killed by them near Detroit and serious commotions had occurred among the Grand River tribes arising through a determined attempt to assassinate Joseph Brant, made by one of his own sons, in which the young man lost his life.

For some years the wily Mohawk chieftain had been suspected of double-dealing and the Governor had just been informed that he was then on his way to consult secretly with the American Superintendent of Indian Affairs.

In his despatch to the Duke of Portland remonstrating against the withdrawal of the troops, Simcoe bluntly declared that he was unable to

comprehend either the civil or military policy of Lord Dorchester in respect to his province. Profound disgust at finding all his objections overruled, combined with failing health, finally determined him to solicit leave of absence for an indefinite period, or if this were refused, permission to resign. On the 1st December, 1795, he announced that he had been suffering from a slow fever for nearly four months and that his physician advised him to leave Canada in time to escape the hot weather in autumn.

Owing probably to ill-health and despondency the closing months of his administration were not marked by the same restless energy which hitherto distinguished it. His mind was evidently filled with gloom at the thought that all his labor had been bestowed in vain.

The government buildings at York were, however, proceeded with and the military road finished from that place to Oxford.

The last session of the first parliament began at Niagara in May, 1796, and again all the government measures were passed as smoothly into law as anyone could desire. Both houses had become tractable beyond expectation. The great increase of population induced the repeal of certain parts of the act offering a reward for the destruction of wolves. The sole question which threatened to provoke controversy was the presentation of a second petition for the amendment of the Marriage Act which the Governor angrily denounced "as highly improper and menacing" in its language. It was generally believed to have been written by the Reverend John Bethune, a Presbyterian clergyman, formerly chaplain of Sir John Johnson's regiment during the Revolution, of stainless reputation and unquestioned loyalty, yet Simcoe openly spoke of it with needless and exasperating bitterness as "the production of a wicked head and a most disloyal heart." Religious ardour seldom failed to reveal the narrowest side of his character. His determined hostility again caused the question to be postponed and the session terminated "with every mark of good-will and respect for the Government." With the dissolution of the Assembly, Simcoe's connection with the province may be said to have ended, although he continued to be Lieutenant-Governor in name for some time longer.

He returned to England much enfeebled in health and mortified beyond expression at the strangulation of so many ambitious projects for the advancement of his colony. Yet in the face of much apparent failure, Governor Simcoe deserves an honorable place on the stately roll of those who have labored earnestly and well "to lay broad, lay strong, lay deep" the foundations of the British Empire of to-day.

NOTES ON THE POSSIBILITIES OF IRON AND STEEL PRODUCTION IN ONTARIO.

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This paper is a condensation of three papers, read at different times before the Geological and Mining Section of the Institute, none of which have appeared in the "Transactions." The first paper was on the "Laurentian Iron Ores of New Jersey," and the second paper was on the "Iron Ores of Lake Superior."

These two papers were written on the fields developed in the United States because geologically they continue into the Province of Ontario, where they exhibit identical features to those found in the United States.

As will be pointed out later on, the assured abundance of Iron ore, and the magnitude of the mining operations, in the United States, on the same belts as we have in Ontario, have a particularly important and gratifying bearing on the possibilities of permanent Iron and Steel production in our Province, so far as the supply of ore is concerned.

In my third paper, "A few Notes on the Production of Iron and Steel in Ontario," I gave a short comparison between the production of Iron and Steel in Canada and in the United States, and touched on the possibilities of inaugurating an extensive production of Iron and Steel in the Province of Ontario.

THE NEW JERSEY IRON ORE DEPOSITS.

The examination of a geological map of the United States and Canada, such as one compiled by Mr. C. H. Hitchcock for the American Institute of Mining Engineers, shows very clearly the passage of the Laurentian iron carrying rocks from the State of New Jersey through the northern part of New York State across the St. Lawrence, where the Thousand Islands occur, into the north-eastern portion of Ontario.

I have had opportunities of studying these Iron deposits in New Jersey and in Ontario at a number of places. There is a complete geological similarity in the rocks, both consisting chiefly of Gneiss, (Felspathic and Hornblendic or Syenite-Gneiss), Granite, Syenite, Chrystalline Limestone and Magnetite.

In New Jersey the formations are locally divided into: 1. Massive Group. 2. Iron Bearing Group. 3. Gneissic and Schistose Group.

It is suggested that the Iron Bearing Group is the same as the Canadian "Grenville Series." It is also considered in New Jersey that the Iron occurs in true beds, though generally more local than the rock strata. As an example, the "Hibernia" and adjacent mines might be quoted, all of which work an ore bed along a length of two and a-half miles, the ore and the rock walls pitching together. The ore has been worked in the "Hibernia" mine down to six hundred feet, and at that depth there is no sign of it giving out. The width of the ore varies from 4 feet to 25 feet, and the associated rock is chiefly Grey Gneiss.

As a rule in this district Chrystalline Limestones appear generally slightly above the horizon of the beds of Magnetite, near its contact with the underlying Granulites; a few mines have been opened in the Chrystalline Limestone.

The ore is often associated with Hornblendic and Micaceous Gneisses on the hanging wall side, while the foot wall is composed of Grey Gneiss or darker coloured Hornblendic and Micaceous Gneiss, and it occurs in beds conformable to the wall rocks, consisting of pure Magnetite, or mixed with Felspars, Quartz, Hornblend, Augite, Mica, Garnet, Calcite, Pyrite, Apatite, and more rarely with other minerals.

The usual strike is to the north-east, the "pitch" of the ore shoots generally north-east, and the dip of the ore bed is generally to the south-east, but sometimes and less frequently, the dip is found in the contrary direction.

It has been found that as a rule the analyses of the new Jersey magnetic iron ores give a greater amount of phosphorus than usually occurs in the Magnetites of north-eastern Ontario, therefore, in many cases the New Jersey ores are not suitable as Bessemer ores. For example while some of the New Jersey ores give from 60 to 65% of iron some of them give from 44 to 50% iron with from ·06 to ·5 and even to 1% of phosphorus and from ·06 up to 3·5% sulphur. The following, taken from the New Jersey Geological Reports, might serve as examples

	Iron.	*Phosphorus.*	*Sulphur.*
1.	48·00	·47	1·5
2.	59·91	·066	3·5
3.	64·00	——	——
4.	50·00	——	——
5.	62·00	·44	·06
6.	58	1·5	——

The feature in connection with these deposits, which was peculiarly gratifying, was their permanency. The result of many years working in this State has enabled the local geological survey to place on record the fact that "their permanent withdrawal and final abandonment has come not so much from the lack of ore or the exhaustion of the veins, but from the heavy expenses attendant on mining operations at a greater depth, etc."

As an example of this I might quote the fact that the "Hurd Mine" has reached two thousand feet in depth, the "Byron Mine" eleven hundred feet, the "Mount Pleasant Mine" eight hundred feet, the "Dickenson Mine" seven hundred feet, the "Orchard" and "Hibernia Mines" six hundred feet, etc.

The yield in New Jersey has reached as high as nearly a million tons in one year. In 1889 it produced 415,510 tons while in the same year New York State produced 1,247,537 tons from her Laurentian Series.

The above mentioned facts are full of significance to us, for the great bug-bear held before our prospectors or investors is that there is no certainty as to the persistency of the magnetite deposits of north-eastern Ontario, as has been shown by many of them playing out in the small development which we have attempted in the past. There is no doubt that many small deposits may prove disappointing in the future, as they have done in the past, but when we fully realize that the continuation of the same series has yielded such results as I have above indicated, we may rest satisfied that under the stimulation of a permanent demand, and of systematic mining development, there can be no question whatever, geologically speaking, about the ultimate permanent supply to be derived from the magnetite deposits of north-eastern Ontario; that is to say a supply adequate to meet a demand within any reasonable bounds.

IRON ORE DEPOSITS OF THE SOUTH AND NORTH-WEST SHORES OF LAKE SUPERIOR.

The ores on the north-west shores of the lake occur in geological series running uninterruptedly into the Province of Ontario, and the ores on the south shore of the lake we find in similar, if not entirely identical, geological series to those occuring in Ontario, on the eastern shores of the lake, and where it is not impossible that somewhat similar developments may be made.

Therefore, for these reasons I have thought a short description of the Iron ranges in the Lake Superior section of the United States would not be without interest to us, as having a direct bearing on the possibilities of

our own territory, for the Vermillion and Messaba ranges of Northern Minnesota have been followed north-easterly into Ontario, and apparently large Iron deposits have been located on our side of the International line, where, it is a well known fact, that our neighbors in the United States are rapidly acquiring the largest proportion of these discoveries.

These deposits are all in the Huronian formation, and I think it can be unquestionably stated that the Iron ore deposits of the Lake Superior Ranges, as developed in the United States, are the most remarkable for richness and extent at present known anywhere in the world.

The best known Iron ranges to the south of the lake and in the States of Michigan and Wisconsin, are the "Marquette," the "Gogebic," and the "Menominee" ranges, while the "Vermillion" and "Messaba" ranges are on the north-west shores of the lake.

The production of ore from these ranges reached in 1890 nearly six million of tons, the estimated amount being placed at 5,900,000 tons.

It might be of interest to quote from Mr. Berkinbine's figures for 1887 to show the ratio of the consumption of the various iron ores used in the United States in the production of pig iron. Since 1887 the amount of the Lake Superior production has however increased over a million tons but at the same time the production of pig iron in the United States has increased nearly three million tons, largely owing to the immense development in the southern States.

RATIO OF CONSUMPTION IN 1887.

From Lake Superior Ores	44.4	per cent.
" Foreign Ores (largely Spanish)	10.5	"
" Lake Champlain Ores	6.5	"
" Cornwall Ore hills–Pennsylvania	5.0	"
" Alabama Ores	5.0	"
" New Jersey Ores	4.4	"
" Tennessee Ores	4.1	"
" Missouri Ores	3.5	"
" Virginia Ores	3.2	"
" Ohio Ores	2.4	"
" Salisbury Ores	.8	"
" Georgia Ores	.7	"

Many of the iron mines of the Lake Superior region are comparatively new discoveries, yet it is astonishing the manner in which Railroads have pushed into every part of these iron ranges, and, as may be judged from

the figures above mentioned of the ore output, the traffic done by the railroads is something prodigious. The railroads take the ore for the most part to the Lake-board where it is run out of hopper cars into ore pockets in docks especially built for the purpose, whence again it is run into the vessels, without handling.

The ore from the Vermillion Range is chiefly shipped from Two Harbors, that from the Gogebic Range from Ashland, that from the Marquette Range from Marquette and Escanaba, and the ore from the Menominee Range also from Escanaba.

The mode of occurrence of the Iron ore in these ranges may be said in a general way to be somewhat similar. As a rule it is found in a certain bed (or beds) in the Iron bearing formation connected with the occurrence of Jasper, and often with Chloritic or Hydro-mica Schists. The ore occurs in the bed or beds in lens like masses of varying size, and in the ranges alluded to, some immense lenses of solid ore have been opened up. The rocks in the immediate vicinity are generally schists, as above mentioned, and Diorite and Quartzite ridges.

It might be of interest to mention that the manner in which the Cupriferous and Nickeliferous Pyrrhotite occurs in the vicinity of Sudbury, also in the Huronian formation, is extremely similar to the manner in which the Iron ore lenses are found as above mentioned, except that there is no Jasper at Sudbury.

I shall now allude shortly in detail to each of the ranges which I have mentioned.

MARQUETTE IRON RANGE.

The Marquette Range in Michigan, comprises a main range chiefly in Marquette County, striking east and west, 8 to 12 miles wide, and 60 miles long, the ores occur with Jasper and Chloritic Schists, between Diorite and Quartzite ridges. A second smaller range some 10 miles to the south, comprising the Republic Group, also belongs to the Marquette Range, and in which the ores occur similarly.

The ores are fine Hematites and Magnetites. As a sample of the composition of the ore from the main range, the following analyses can be given :

Non-Bessemer Ores.

	Red Specular Ore.	Black Magnetic and Slate Ores.	Soft Hematites.	Flag Ore.
Metallic Iron	62·900	62·90	52·640	49·330
Phosphorus	·111	·08	·078	·053
Sulphur	·050	·13	·110	·030

Bessemer Ores.

	"LAKE SUPERIOR."	"CHAMPION."	"REPUBLIC."
Metallic Iron	64·80	67·00	65 to 71
Phosphorus	·06	·03 to ·054	trace to ·07
Silica		3·00	0 to 4·6

The Mining commenced in 1854 in this district and some of the mines are from 500 to 700 ft. deep. Since mining started to the end of 1888 about 27,011,998 tons were mined from this range.

The only mine I went down in this range was the Barnum Mine at Ishpeming. This mine yields a hard ore, from a close grained to a semi-crystalline hard specular ore. The ore lies between a Jasper, on the foot wall, and a hard compact grey, and probably silicious Hydro-mica Schist on the hanging wall. The ore varies in thickness from 4 to 40 ft. and as the ore is hard, pillars are left and there is no filling or timbering.

There are three styles of working on the "South Shore." 1. The hard ore, with pillars as above mentioned, and the soft ore; by 2. Nevada timbering; and 3. Filling in earth and debris in the space left where the ore is taken from.

Perhaps the most wonderful of these many rich iron ores is the "Republic" micaceous hematite. The mine is worked by 8 shafts, one of which is 1000 feet deep. The ore body generally strikes east and west, but at the east end it twists round and strikes north-west. Hanging wall is quartzite and footwall jasper; but between both walls and the ore there is a lining of soapstone (hydro-mica schist) which in places surrounds the ore. The Jasper and ore are 100 ft. thick.

THE MENOMINEE IRON RANGE.

The Menominee Range only commenced shipment as short a time ago as 1877 when 10,405 tons were shipped. This range is south and a little east of the Marquette Range. It is 8 to 12 miles wide and about 45 miles long (from Iron River to Wacedah). The ores in this district are generally red hematites and partake of the same general characteristics as similar ores in the Marquette district, except that they are as a rule softer. They are found in large deposits. The largest producing mine in the district—The Chapin—is a soft blue hematite.

The following analysis shows the grade of ore produced from this range.

	"Chapin."	"Vulcan."	"Cyclops."	"Norway."	"Quinnesec."
Metallic Iron ..	63·00	63·900	60·400	58·900	67·00
Silica		6·800	3·300	12·200	4·80
Phosphorus	·07	·013	·009	·016	·01

Total output of range to 1888 was 8,547,126 tons.

Three mines in this district, the "Chapin," the "Norway" and the "Vulcan" have produced nearly four million tons of ore since opened. The former mine has averaged nearly 200,000 tons a year since it was opened and in 1887 exceeded an output of 300,000 tons. I visited this mine and was much struck with the magnificent machinery. The hoisting engines for example have 30" and 60" double cylinders acting direct on two conical wrought iron drums of an average diameter of 12½ feet. The chief feature, however, about the machinery in connection with this mine, and other smaller mines operating at Iron Mountain, is the fact that all under-ground power, for pumps, motive power, drills, etc., is supplied by compressed air from three miles off. The largest compressing plant ever built is situated at Quinnesec Falls on the Menominee River, 3 miles from Iron Mountain, driven by water power. This plant consists of three pairs of 32" x 60" compressors, driven by three independent vertical 48" inward flow turbines, and one pair 36" x 60" compressors driven by a 54" turbine. The delivery of air through a 2 feet wrought iron pipe is stated to be 1,827,350 cubic feet of 60 lbs pressure and 60° temperature per 24 hours.

Full details of the mode of working adopted in the "Chapin" mine (where a filling in process is adopted by waste or earth brought from the surface to fill the space left in mining the ore) is to be found in a paper by Mr. Per. Larsson, read before the American Institute of Mining Engineers, and much other information of value is also given in the paper.

The ore occurs in lenses, of which three have been worked in this mine. The main lens is 60 feet to 75 feet wide, and has a length of some 2,500 feet. The strike is with the strata N. 70 degrees W. About 800 tons a day are mined, and 600 men employed.

THE GOGEBIC IRON RANGE.

The Gogebic Iron Range runs nearly parallel with the southern shore of Lake Superior, and about 15 miles distant from it. It is about ¾ to

1 mile wide, and 30 miles long. The Montreal River (which is the boundary between the State of Wisconsin and the upper Peninsula of Michigan) flowing northward into the lake, cuts through the range nearly midway between the extremes of the present exploitations, about one half of the ore strike, as now believed to be determined, lying in Ontonagon County, Michigan, and the other half in Ashland County, Wisconsin.

There seems good reason to believe that the ores lie in lenses of greater or less width and depth, throughout an ore bearing stratum, confined by quartzite, which is very regular, and diorite, which in places is decomposed into so-called "soap rock." In places small quantities of Kaolin is found formed from the decomposed felspar in the diorite. The dip of the ore bearing rocks is 65° to 70°. Most of the analyses of the Iron ores show that they are rich in metallic Iron, from 50 to 66 per cent., very low in Phosphorus, variable in Silica and free from sulphur. The Colby mine as an example shows metallic Iron from 48 to 65%; Phosphorus ·04 to ·08%; Silica, 2 to 8%; and Mn. 1 to 11%; analyses from a number of other mines show, Fe. 51 to 65%; P. ·02 to ·08%; Si. 3 to 5%; and a little Mn. in some ores.

This range was only opened in 1885, and the results have been simply prodigious. From a wilderness a very few years ago, it has by means of railroad communication, been opened into a thriving populous district. Several railroad systems now run into this range, which has outstripped the older ranges.

As an example of the ore deposits I might mention the "Ashland Mine" which I visited. The strike is N. 80° E. Dip of foot wall 65° N. On the property there are 4 lenses of ore dipping to the North and pitching to the East. The width of ore is 220 to 240 feet in widest part. The usual manner of working in this district, as I saw it in this mine, is by running a slope down the quartzite foot wall and running levels from it.

The footwall is quartzite, into which they ran 68 feet, below that is bluish argillite, and below that to the south is granite. Diorite, varying to crystaline hornblendic rock, is seen on the hanging wall; and next to that come mixed ore and quartzite, then alternating bands of diorite mixed ore and quartzite.

Nevada style of timbering is used and there are 3 million of feet of timbering in this mine. As an example, the first room is 140 feet wide by 60 feet high and 70 feet long, and this space is all built up with timber.

The ore is an open hematite in layers with cavities, looking very much as if it was for the most part the result of a secondary formation; some of it is hard steel blue ore. At the "Germania Mine" in the same range,

where the ore body is said to be 20 to 30 feet wide, I examined the ore on the stock heaps. As a rule it is a soft red hematite, in small pieces like coarse sand, but all angular; much of the ore is also harder and shews a lamination in flat open texture with ochreous stains, there is also hydrated and brown ore in places, and as an exception it occurs as a solid steel blue ore very close grained and called "blue ore."

VERMILLION AND MESSABA IRON RANGES.

In Northern Minnesota, near Vermillion Lake, there is an Iron range of great richness, containing hard hematite ore deposits of very large size. This was opened up in 1884, by the Iron Range and Duluth R. R. The shipments from this range have been:

In 1884	62,124	tons.
" 1885	225,484	"
" 1886	304,396	"
" 1887	394,252	"
" 1888	450,075	"
" 1889	864,508	"
" 1890	875,000	"
" 1891	900,000	"
Total	4,075,839	"

At "Tower" there are a number of openings or mines, namely:

North Ridge.

"Tower No. 1."—Ore body 20 to 60 feet wide as an average, and at one point 155 feet wide.

"Tower No. 2."—Ore body 100 feet wide.

"Ely Mine."—Ore body from 20 feet to 120 feet wide.

"Stone Mine."—Ore body from 6 feet to 120 feet wide.

"Stuntz Mine."—Ore body from 20 feet to 60 feet wide.

"Breitung Mine."—Ore body from 10 feet to 40 feet wide.

South Ridge.

"North Lee."—Ore body from 30 to 40 feet wide.

"South Lee."—Ore body about 20 feet wide.

The quality is shown from result of 150 analyses by F. Prince, in 1887, which gave an average content of Iron 67·7%; P. 0·06%; Si. 1·5%. The ores are generally separated into three grades, namely: "Red Lake" 57%; "Minnesota" 62%; "Vermillion" 67% Iron. All the

mines are large open cuts, but arrangements for deep mining are being made.

There are two ore ranges near Tower, the "Vermillion," which is hematite, and further to the S.E. the "Messaba Range," which yields chiefly magnetic ores. This latter range yields ore running from 50 to 60% metallic Iron, and ·01 to ·16 in Phosphorus.

The Vermillion Range has been followed in a N.E. direction for 25 miles to Ely, where the "Chandler Mine" has been opened up. Of this deposit Mr. H. S. Pickands says: "The vein has been proved for a length of over 100 feet, and a depth of 90 feet, showing at every point of test high quality Bessemer Ore." The analysis of the ore is Fe. 69 to 66; P. ·01 to ·03; Si. ·8 to 4%. The deposit has been tested by drill to 306 feet in depth. Between "Tower" and the "Chandler" Mine, in about a straight line, the formation of country rock and Jasper is nearly continuous; but although much exploration work has been done, no other remarkably valuable deposit of ore has thus far been found. To the east of the Chandler the same may also probably be said. The formation extends almost unbroken, in a north-easterly direction, to the Canadian border, and shows ore at various points. A lean black ore outcrops for miles in length and of great width, but as yet determined, its Metallic Iron is not over 50%, and Silica from 20 to 30%.

CONTINUATION OF THE VERMILLION RANGE IN ONTARIO.

In the vicinity of "Gun Flint" Lake and "North" Lake, on the Canadian side, undoubtedly good magnetic ore has been found, analysing Metallic Iron 68%, Phosphorus ·028%.

At other places on "Hunters' Island" and near "Knife" and "Basswood" Lakes, good ore is also reported to have been found. There is every reason to believe that this Iron bearing formation runs N.E. up as far as the Kaministiquia River. To the west, at Attikokan Lake, there is also said to be a very large deposit of a high grade Magnetic Iron ore.

I have, I think, proved conclusively from the foregoing that, in order to supply any reasonable demand for iron ore in the Province, it is merely a question of exploration and mining development. I shall conclude by making a few statements; Firstly, on the alleged necessity of our iron ore to the United States; and, Secondly, on the advisability of smelting our own iron in Canada, and particularly in Ontario.

SUPPLY IN THE UNITED STATES.

In the first place we have constantly been told that the iron ores of the United States are becoming exhausted and that, therefore, they must

in the immediate future have our ores. This is quite erroneous as I can testify from personal observation and also from the reports of correspondents in the annual statistical number of the *Engineering and Mining Journal* of this present year.

Though the increased consumption in the United States during this past year has been enormous, yet the development of new deposits has been so much greater that the supply is more than enough to meet the demand.

Take the report on the "Lake Superior Iron Ore market in 1891," as an example and we find it stated: "Large deposits of soft ore have been discovered in the Gogebic and Western Menominee district, which owing to their great size and in many cases proximity to the surface, have been worked at a cost much less than was necessary to produce a ton of ore from the old hard ore mines of the Marquette County district; it can be readily seen that the prices which ore brought on cars at the mine ranged from $1.00, for the lowest grades, to $3.50 per gross ton for the higher grades. Now no mine produces only the higher grades. The production of most of them consists of a variety of grades, ranging from the lowest to the highest. . . . . Some companies only produce the lower grades, etc."

Also in the case of the Southern States, Tennessee, Alabama and Virginia, the reports are unsatisfactory, it being stated: "It has been evident to all unprejudiced observers that much unwise haste has been made in the South in the production of pig iron, for which there was no local demand. It is obvious that while 80% of the pig iron produced in the Southern States has to be sent away from home to find a market, competition must be exceedingly severe, and only those plants which are well located and possess every advantage can hope to survive. Numerous furnace companies have already fallen by the way and others are now sick unto death."

With the above facts before us we must once and for all accept as final the fact that our iron ores will not be essential to the United States for many many years to come, and that our best policy is to develop them and use them ourselves.

SMELTING IN ONTARIO.

I now come to the advisability of smelting our own iron in Canada and particularly in Ontario.

So far as available statistics go to show we are practically standing still, if not actually receding, in our manufacture of pig iron, while in

the United States, under a more vigorous iron policy, they are advancing with marvellous strides, and to-day are the greatest iron and steel producing country in the world, having at last outstripped Great Britain.

The following figures speak for themselves. Those of Canada have only been available for the last few years.

PRODUCTION OF PIG IRON IN THE UNITED STATES.

	Net Tons.
1860	919,770.
1873	2,868,278.
1882	5,178,122.
1890	10,307,028.

PRODUCTION OF PIG IRON IN CANADA.

	Net Tons.
1887	24,827.
1888	21,799.
1889	25,921.

In the United States they produce ·164 of a ton of pig iron per capita of the population. In Canada we produce ·003 of a ton of pig iron per capita of our population.

In the United States they produce 400 times as much pig iron as we produce in Canada, and yet their population is only twelve times that of the Dominion. Or *in the United States each person has 54 times as much pig iron manufactured for him in his own country as he would have if he lived in Canada.*

This comparison is drawn not for the purpose of belittling the efforts of those among us who are striving to build up our metallurgical industries, but to invite attention to the disparity which is exhibited in the working results and which no one can believe legitimately exists in the possibilities of the two countries.

I boldly make the assertion that Canada's greatest deficiency lies in not producing her own iron and steel.

We have built magnificient railroad systems, have created splendid steamship lines and are constantly projecting others. These may be said to be our greatest works, but what are they but *Iron* and *Steel?*

What if we had produced it all in Canada, and were now manufacturing that which will be used in all the newly projected railroads and steamships lines, to say nothing of all the multitudinous require-

ments of everyday consumption of the king of metals? We can say at least that there would be a million more people in Canada to-day.

We cannot point to any nation in the world that amounts to anything which does not manufacture its own iron and steel.

One who has never visited a "black country" cannot conceive the stupendous scale of each member of the family of industries that goes to make up the creation of iron and steel. First the underground world teeming with miners to produce the ore and coal, or the busy neighbourhoods where the forests supply charcoal, the great traffic of these products to the railroads to some central point for smelting, the men day and night round the blast furnaces, the swarm of workmen at puddling and rolling the product, if iron, or converting the pig into steel and then rolling it. In all of these the consumption of nearly every other product is so prodigious that a thousand other trades are permanently benefited, from the farmer, who produces food for the workman, to the cloth maker who turns out his Sunday clothes.

A Royal Commission reported last year on the mineral resources of Ontario, and in connection therewith some information was given about this question of Iron and Steel Smelting. The report states on page 21: "The industry is of first class importance and every proper means should be taken to secure its establishment in Ontario;" also on the same page: "It is unquestionably n a country's interest not only to smelt its own ores, but to refine and manufacture the metals, providing always that the various operations can be carried on economically and without taxing other interests indefinitely for their maintenance."

With regard to fuel, I may state the above mentioned Mining Commission reported that there is no more favourably situated district for charcoal iron smelting in North America than Eastern Ontario. In this connection I would add that the Rathbun Company, of Deseronto, is shipping large quantities of charcoal to the United States, and it is a known fact that for a long time charcoal has been shipped from Essex to Detroit chiefly for iron smelting purposes.

With regard to coke let me briefly remark that the Illinois Steel Company at Chicago produced in 1890 the largest output of steel rails of any firm in the United States—nearly a million tons (exact amount 925,000 tons), and we should not have to bring our coke or ore so far to the works—say at Toronto.

A new and great factor in steel making, as you all know, has recently appeared. Mr. James Riley, of Glasgow, and others showed that structural steel could be improved in quality by alloying it with from one

to five per cent. of nickel; and carrying out the tests on a larger scale, recent experiments at Annapolis proved that armour plate made of steel containing nickel was superior to any other plate.

These facts and the statements in the New York *Mining Journal* in connection with the Sudbury deposits (and which my observations lead me to believe are correct) "that the Canadian mines alone could supply the whole demand in the world even if the other sources did not produce anything" give to us a new interest in this question of manufacturing steel, as well as gratifying information as to the supply of this new element which, without doubt, will enter into its composition in the future.

THE AVAILABLE MARKET FOR HOME PRODUCTION.

I shall, lastly, briefly touch on the question of market. I merely allude to home market, for what foreign demand might spring up for a superior grade of nickel steel, did we make it, I shall not attempt to predict.

The fact that I previously pointed out that a man living south of the 49th parallel has produced for him in his own country 54 times as much pig iron as if he were located to the north of the said line, seems to prove to me one of two things, namely, that there is a great deficiency that can be legitimately made up by smelting and manufacture, or that the average Canadian is lower in the scale of civilization than I believe him to be.

I think if the matter were thoroughly investigated that a Canadian uses per capita as much iron and steel as an inhabitant of the United States.

As to the amount of the consumption I do not think I could quote anything more disinterested as authority than the geological survey of Canada. In the report for the year 1887-88, page 37 of part S, we find that "during the years 1886 and 1887 there were imported for consumption into Canada 345,000 tons of pig iron and 283,000 tons of steel. If to this is added the amount of pig iron consumed as such, it will be seen that, excluding all the iron and steel entering into such highly manufactured articles as cutlery, surgical instruments, edge tools, machinery of all kinds, engines and many other hardwares and manufactures, there was a total consumption equivalent in pig iron in 1886 and 1887, respectively, to about 415,000 tons and 356,000 tons. If made in the country, this quantity of pig iron would represent to our makers at actual prices a value of about $5,000,000; it would necessitate a yearly supply from Canadian iron mines of 1,000,000 tons of ore, and, before

this ore could be melted into pig iron and further made into the different mercantile articles of iron and steel, which are now imported, it would also require about 3,000,000 tons of coal."

Taking this amount, say 400,000 tons (which we must believe is constantly increasing from year to year), *we have the product of 27 to 28 blast furnaces being used per annum in Canada*, instead of what we often hear—that one blast furnace would glut our market. I take the basis of furnace output, the standard adopted by Mr. Bartlett, alluded to in his evidence before the Mining Commission.

If however, we take the wonderful yields of the latest Edgar Thompson furnaces, the market would be supplied by a smaller number of furnaces, but even on the liberal standard of the Lucy furnace (No. 2), yielding 91 tons per diem, we should need some 20 blast furnaces to supply our demand, when we make allowance for an average number being out of blast.

In 1879, after I had been for some time at smelting works in North Staffordshire, I wrote an article, "A Few Words About Iron," in the *Canadian Monthly*. In it I pointed out that iron of the finest quality was being produced at that time in North Staffordshire for $5 a ton, while it was costing $20 a ton at Pittsburg to smelt a bessemer grade, prices in both cases not including management, interest, etc. I then stated that I was at a loss to know how we in Canada were to build up our iron and steel industries under a smaller protection than the United States.

I have yet to be enlightened on that point, and the existing state of affairs seems to indicate that no satisfactory basis has yet been arrived at. It would surely be better to have no protection than a half-hearted one, which is a tax on the consumer and yet one which will not build up a national industry.

The expenses in connection with the establishing of smelting works are so enormous that without a policy which says "*We* ARE *going to smelt our own iron and steel*," little can be hoped for.

But once that policy is adopted, whether by protection or by bonus, and the gigantic industries can be launched and set running, we shall have taken a greater step in the commercial development of our country, even than by building the Canadian Pacific Railroad.

A very practical, and I believe satisfactory solution, so far as Ontario is concerned, would be for the Local Government to offer a bonus, similar to that of the Dominion Government, on iron and steel smelted in the

Province during a term of years, and the Dominion Government should encourage the manufacture of steel rails in Canada.

This question is one of immense, nay, of vital importance to us who are citizens of the Province of Ontario. There ought to be no point more favourably situated. Iron ore can be brought from the north-east, nickel from the north-west, and coke from across the lake. The magnitude of the operations can be realized when I say that, from my personal knowledge, one private works in England paid in wages alone $40,000 a week.

And not only Ontario, but the whole Dominion would be benefitted if we smelted our own iron and steel. Iron ore occurs in so many places that it is difficult to say what part of the Province might not be directly benefitted by mining, besides the general renewed prosperity it would give to the whole country.

OTTAWA, January 1st, 1892.

Alan Macdougall, Esq.,

Corresponding Secretary Canadian Institute, Toronto.

SIR.—I am desirous of bringing to the attention of the Canadian Institute a subject of more than ordinary importance, and to my mind, especially so at this period in our history. I beg leave to refer to the accompanying "Note" by which it may be seen that the design in view is the removal of certain evils which unfortunately beset us as a people.

I cannot resist the impression that the examination of the facts presents a scientific problem, in no way unworthy the consideration of the Institute; and if a solution of the difficulties presented be possible, it can best be obtained by bringing the subject to the attention of properly qualified minds. It is the duty of us all to seek the best means of serving our country, and on this ground I appeal to the Institute to extend its consideration to the matter which I respectfully ask permission to lay before its members. The Institute, from its recognized character as a scientific and literary body, holds a peculiarly favourable position to entertain the consideration of the subject. It may be briefly described as an inquiry into the possibility of rectifying our electoral and parliamentary system, with the view of averting many evils now attending it, and of promoting the common happiness by terminating party conflict, and assuring political peace and freedom, by the removal of the painful and depressing influences from which we suffer.

I feel therefore warranted in appealing to the Institute, as a body non-political in its corporate character, but which, nevertheless, is representative through its members of all shades of opinion, to give the weight of its name in directing public attention to the subject.

I trust I am not too sanguine in expressing the hope, that by the weight and influence of the Institute, so great and so general an interest in the subject may be awakened, as to lead to important and beneficial results. Should a practical solution to the problem be obtained, it will be attended with the happiest consequences, and the Institute will have conferred a lasting benefit on the Dominion.

Along with the accompanying "Note" I enclose a list of writings bearing on the subject of this communication, some of which are of deep interest.

I have the honor to be, Sir,

Your obedient servant,

(Signed) SANDFORD FLEMING.

NOTE ON ELECTORAL REPRESENTATION AND THE RECTIFICATION OF PARLIAMENT.

There are in Canada few men past middle age, who have not long felt the unsatisfactory condition of much which appertains to public life in the Dominion. There are not a few who have from year to year hoped that the unfortunate features in that which we call "politics" would in some way disappear. Recent revelations have, however, rudely dispelled such hope, and have confirmed the fears of those who foresaw that as the tendency of the evils was progressive, we could not reasonably look for an improvement.

Thoughtful persons, having the welfare of the country at heart, are thus impelled to give serious attention to the subject, with a view of considering the possibility of securing some beneficial change. The examination naturally takes the direction of an enquiry into the origin of the evils with which we are confronted, and the causes which persistently keep them associated with government, which, therefore tends to become mis-government.

The objects of government may be thus defined: To maintain peace and security, to increase prosperity and wealth, to advance moral and intellectual development, and generally to promote the good and the good-will of the people.

With us the universal belief is, that the representative system is best calculated to attain these ends. In other conntries the representative system has long been a constitutional reality, and from time to time modifications have been made in the system to render it more workable and more beneficial; but, notwithstanding the various changes which have been made, it cannot be held that its full and complete development has yet been attained. In Canada we are familiar with many of the defects of popular government. In the neighboring republic the defects in its adaptation are still more marked, and the political condition is consequently far from satisfactory. In Great Britain, the cradle of modern representative government, where the system should have attained the highest perfection, similar evils have been developed.

That the political evils which everywhere attract attention are attributable to imperfect methods of carrying out the representative system may justly be inferred. The fundamental principle of representative or

popular government is, that the sovereign power of a State rests in and proceeds from the people, and that it is exercised by the representatives of the people assembled in Parliament. We have accepted this the democratic theory as our principle of government; but an examination will show that the methods adopted in carrying it into practice, have failed in their object. We, in fact, follow a course which, in its results, operates in a manner diametrically opposed to the true theory of our political constitution. The theory is that the mass of the electors shall be present in the persons and heard in the voices of those who constitute the national assembly or Parliament. Such undoubtedly is the principle of government which we aim to carry into effect, but it has never in practice been even approximately attained; moreover, it is impossible of attainment so long as members of Parliament continue to be chosen according to the present method of election. The obstacles to obtaining a true representation of the people in Parliament are due to the combined influence of two causes. The *first* is the expedient universally adopted in choosing members of the legislature by a majority of votes in each constituency. The *second* is the division of the people and the representatives into two great parties. The second, indeed, follows in a great measure from the first; undoubtedly the primary radical error is in assuming that the aggregate numerical majorities in the several constituencies are representative of the whole community. On this assumption, all those who do not vote with the majorities are unrepresented in Parliament. The aggregate majorities represent only a portion, in place of the whole people; the electors who voted for the defeated candidates, together with those who had no vote, or did not vote, remain unrepresented. Under these circumstances, even if the whole elected body gives its unanimous support to the administration, we do not obtain a true and perfect model of popular government, that is to say, a people self governed. We have but the government of a part over a part; possibly, but not necessarily, the major over the minor part. It is proper, however, in considering the question, that we should deduct the members in opposition, and then we still less have the government we are told we possess; that is the government of the people. We then have practically government by the minor over the major part. It can be conclusively shown that the minor and governing part is but a fraction of the whole, and that we are, as a matter of fact, usually governed by this fractional part. There cannot be a doubt that from this circumstance spring the unhappy forces which so much disturb the harmony of our political machinery.

It has elsewhere been made clear by actual statistics, that the electoral methods which we follow prevent a large portion of the community from being represented in Parliament, and exclude a still larger portion, gener-

ally the great majority of the people, from any share or participation, directly or indirectly, in the government. It has been likewise established that in place of the supreme power being exercised by the people's representatives, the whole power of the State is absolutely possessed by a minority, and practically by an exceedingly small minority. Thus we utterly fail in attaining what is understood to be representative government; in its place we have acquired a totally different and perverted system—a system of the character of an oligarchy, and, it is hardly too much to say, exhibiting some of its worst features. We have accepted the fallacy that a part is equal to the whole. We give supreme authority to a part, numerically in the minority, and we allow it to assume the power which should be exercised by the whole; at the same time we exclude a large part, generally the majority of the people from the rights and privileges which by theory they possess.

Is it surprising that this system should result in the constant recurrence of difficulty? Would it not rather be a matter of surprise if those excluded from participation in government, or from representation in Parliament, should quietly acquiesce in the injustice? It is only natural that they should resent the deprivation, and strive to regain their lost rights and privileges, by waging political warfare against the men who for the moment rule; hence it is that they employ every means, good and evil, to drive them from power. The dominant party for the time being, on their part strenuously defend the position they hold, and leave nothing undone to thwart the efforts of their adversaries to displace them. On the one side, there is a persistent and relentless attack upon the party controlling the government; on the other a life and death struggle for political existence. Thus we have the political peace of the community continuallly disturbed, and we witness, in and out of Parliament, a never-ending conflict with all its concomitant evils. Such to-day is the chronic condition of public life in Canada, whatever party be in power, and it seems to be much the same in all countries similarly circumstanced. In the work of Sir Henry Maine on popular government the condition of party government, is mildly described as "a system of government consisting in half the cleverest men in the country taking the utmost pains to prevent the other half from governing."

It is easy to be seen that the source to which we may trace our political difficulties is an incomplete, if not absolutely false, electoral system. The method of election which we follow, in its effect disfranchises half the population entitled to representation in Parliament, and, without any doubt whatever, it is this grave defect in our political system, which throws all our constitutional machinery out of gear. It is this defect which

brings the organized parties of the present day into being, and which animates and intensifies party feeling. It is this defect which leads to party abuses and vices, and while this defect remains, improvement is not probable, indeed, unless humanity changes its nature, it may be affirmed that any marked improvement is not possible.

Glancing over the pages of history, it cannot be denied that a party had its good side as well as its bad in the early days of representative government. There were special objects to be attained, and questions of great importance to be settled. But great questions do not last forever, in some way they are disposed of, and one by one disappear from the political surface. If parties had depended on great questions to keep them alive, they would have long since perished, and would not to-day be known as permanent organizations. With truth it may be said that we stand upon the graves of great questions, and it is impossible to conceive that the ghosts of dead issues are of themselves sufficient to maintain the vitality of parties for any length of time. But every effect is associated with a cause, and the parties which flourish to-day have other and adequate cause for their continued activity. Until this cause be removed, parties will survive as living antagonistic forces to disturb the peace and political harmony of the nation. Until the day comes when Parliament shall be properly constituted, and we have representative government, *in fact*, we cannot look for a truce in political warfare; until the whole electorate be fairly represented in the national assembly—a cessation of hostilities is, in the nature of things, impossible.

In order clearly to understand a guiding principle of party government and gain an insight into the ideas of leading party men, let us endeavor to ascertain their aims and aspirations. Suppose we ask those in opposition to the ruling power what their views are with respect to the future. Will they not declare their determination to gain office, and that their hope and desire is to hold the reins of government permanently? If we make the same enquiry of the ruling party, will they not tell us that they have no intention of throwing up the power they hold, and that they will, if they can, retain power always.

Is not the cardinal idea of each party, that it shall exclusively rule? That is to say, the ideal government of each for itself is a class government, the class to consist of the men of the party. If this be the logical inference it seems to be indisputable, that party government is utterly at variance with free institutions.

All history goes to prove, and it is indeed a necessary result of our human nature that the end of government is primarily and essentially

the welfare of the ruling class. If an oligarchy governs, the first and great aim is the benefit of the oligarchy. Similarly with respect to a party, and the consequences are the same whatever party may govern. This rule has always obtained, and we may rest satisfied that it will be the rule to the end of time. If, therefore, our object be the welfare and well being of the whole people, it is perfectly clear that the whole and not a part must govern. It becomes a fundamental necessity, therefore, that some way must be devised by which we shall obtain government by the whole people, or by representatives or deputies of the whole people, if we are to make any advance in the art of government.

It is quite true that in Canada we follow much the same methods as in Great Britain, where representative institutions took their origin, where the greatest experience has been obtained, and where we look for the highest perfection. It is undeniable that elections determined by the numerical majority of votes, and the division of the electors themselves into two great parties, are methods which have been practised in the mother country more or less since the latter end of the reign of Charles II. It must nevertheless be admitted that the numerical majority system is but a rough and ready means of choosing representatives, and that party government is found in the United Kingdom as elsewhere to be productive of serious political evils. Moreover, even if these traditional methods be held to be the only available means of carrying on government in a country which has emerged from feudalism, the circumstances of their application on this side of the Atlantic are not the same. Here the whole people are on equal footing. There is no privileged class, all are equal in the eye of the law, possessing identical rights and privileges. It is our pride to be in close alliance with Great Britain, and our boast to be an integral portion of the British Empire, but in local government we possess the fullest measure of independence, retaining control of our own affairs, untrammelled by the hereditary rights and practice which spring from past social and political conditions. In the mother country there are ways and usages which are historically intelligible, and among them may be classed the political methods we have named ; the circumstances on this side of the Atlantic are however different, and there will be less difficulty in discarding such ways and usages, if they are found seriously to impede progress or interfere with the essential principles of representative government, "the government of the whole by the whole."

In Canada we have been accorded full liberty to manage our own affairs substantially in our own way. There is no cast iron rule which we are bound to follow ; there are no theoretical impediments to consti-

tutional changes which we may generally desire; no reason can be adduced why we should rigidly adhere to usages of the past, if we have been made to feel that they are productive of evil.

Feeling clear on these points, two courses are open. First, we may adopt the *laisser-aller* policy, and allow matters to go on as now, with the prospect, nay, the certainty, that the evils we experience will become greater, and even more confirmed. Second, we may make an honest attempt to rectify Parliament, and obtain a government based on the true principles of popular representation.

If we are satisfied that some change in our political methods will be advantageous to us, we are not only free to make the amendment, but it is a duty which we owe to ourselves and to our posterity, to endeavour as much as we are able, to perfect the organization of representative government, so that in this Dominion it may attain the fullest development and most symmetrical form.

Following the second course, the problem which challenges our attention is: to devise a scheme of electoral representation, by which the whole electorate may be equally recognized in one deliberative body, and every elector may have an equitable share through Parliament in the general administration of public affairs. It is, in short, to perfect our constitutional system so that every interest within the Dominion shall be fairly represented in its government.

This problem may be difficult of solution, but considering its vast importance it ought not, in this inventive and constructive age, to be insoluble. What is a party but a portion of the people organized for political purposes? If it be practicable to organize two political parties in the community, it should be quite possible to form one organization, the outcome of that one organization to be the Parliament we are in search of. We are led to think that political organizations are costly affairs. In the one case, each of the two parties obtains funds from private sources or secretly and improperly from public sources. In the other case the expenditure on a single organization would be purely in the public interests, it could be made openly under the highest authority and be a proper direct charge on the public exchequer.

The writer has elsewhere given expression to his views on this subject, and has submitted certain principles by means of which Parliament might be constituted so as to represent truly the whole electorate. While he does not attempt to furnish a scheme, complete in all its details, the maturing of which would indeed require much time, much consultation

and much consideration, he ventures to think that such a scheme as the circumstances demand, could, without great difficulty, be arranged and made perfectly workable ; that while conserving all that is good in our present constitution, and without involving any radical or revolutionary change, we could have presented to us a plan by which we would realize in our parliamentary system the true idea of representative government.

In forming a new scheme of electoral representation, the central idea should be to constitute Parliament so that in reality it will be "the nation in essence." With this central idea constantly in view, it would be found that no good purpose could be secured by giving exaggerated importance, as is often done at present, to abstract political questions during the period of a general election. It would be in the interest of the whole community to choose men to sit in Parliament who are best qualified by common repute to represent the electoral mind, and to leave the settlement of all public questions to the assembled legislature. Representatives ought not to be considered mere delegates to echo conclusions, dictated perhaps by whim or passion, or formed on insufficient evidence and immature judgment. It is well known that often during general elections one question brought into prominence will decide which party shall rule ; while in Parliament many questions arise, some of which may involve far more important considerations than the one which receives special attention at the moment of the election. It is not sufficient that members should represent their constituents on the one question, or on several questions. The electorate should be well and thoroughly represented on all questions which may arise throughout the duration of Parliament. What is needed in a member is a man of rectitude, good ability and good sense, in direct touch with, and in full sympathy with those whom he is called upon to represent. The duty of the electors is to select the men who have the proper qualifications, and leave the final settlement of every public question to Parliament. When Parliament assembles, each representative should feel himself unpledged, and free to speak and vote on his own clear convictions, unbiassed by preconceived opinions, formed possibly upon incomplete information. In Parliament a member following a debate has the means of acquiring a more perfect knowledge of the subject under discussion than he previously had, or which the generality of those, who have selected him to represent them, could possibly have. The position of a member provides the best opportunity of obtaining familiarity with all sides of a public question. He will hear the most eminent men in public life, he will have access to the best evidence which can be obtained. For all these reasons, repre-

sentatives of the people in Parliament should be left free to act according to the dictates of their own judgment, after full examination, and full consideration of every subject. It is not possible for an electorate to determine in advance, the varied demands for legislation or the conclusions which should be reached on the many questions which will arise.* The greater is the necessity, therefore, that they should select men of the proper calibre to represent them, men whose ability and reputation is well established. The representative on his part will owe his constituents the exercise of his best judgment and the maintenance of perfect rectitude in all matters.

This point has an important bearing on any new scheme of representation. While the electorate has the right, and should whenever necessary, exercise the right to discuss public questions, it is obviously infinitely more important for the constituencies to obtain as members, intelligent independent men, known to be generally sound on vital questions, in preference to those who are willing, in order to obtain a seat, to pledge their opinion on any given question.

Legislation is not so simple that it may be undertaken by any one. It is not a matter of indifference who undertakes it, or what character of legislation is obtained. We should have as legislators the wisest, the most clear-headed, the best informed, the most just and honest members of the community. The average elector may or may not be well grounded in matters of legislation, or in forming correct opinions on all subjects; but he can, without any doubt or difficulty, exercise his judgment as to who he can trust, and it becomes him to choose some trustworthy man as his proxy to represent him and deliberate with other trustworthy men; and having done so, he can leave the decision on all legislative questions with confidence to the Parliament which they would constitute.

A Parliament so constituted would be a miniature copy of the aggregate

* It would be absurd to throw on the people at large the actual work of legislation,—since the people only form general aims and wishes, for which it is the business of the legislative expert to supply appropriate particular rules fit to be enacted,—but that these general aims and wishes should be regarded as paramount by a representative legislature. And certainly it would be difficult for the citizens at large to perform effectively the complicated discussion that is often required to mould a legislative scheme into the most acceptable form. Nor would it be practicable for the constituents to direct the action of the representative in every detail during such discussions; since it would sometimes happen that compromises and modifications were suggested at the last moment, rendering any previously expressed wishes of the constituents irrelevant to the issue finally put to the vote; while to give time for a reference to the constituencies in all cases would involve intolerable delay.—*Sidgwick, Elements of Politics London, 1891, p. 529.*

electoral mind—a microcosmus of the world it would represent. The legislature of the country would become a focal center, where all the currents of national life would mingle unembittered by party feeling, where all aspirations and impulses would come into friendly contact, where the different rays of public opinion would meet under the most favorable conditions, to modify each other into a unity of expression.

Among the important consequences to which a rectification of Parliament as proposed, would lead, there would necessarily be a modification in the formation of the executive, and in the relation of the ministry to Parliament and the people.

In order to maintain the harmonious operation of every branch of government, the chief executive and administrative body ought to be in full unison with Parliament; that is to say, Ministers of the Crown should have the entire confidence of the representatives of the people. As in Great Britain, we retain in the Dominion the form of Monarchy in connection with democratic principles. In all forms of government there must be a central authority, from which the national power for the time emanates; the same holds true in this respect in a Republic as in a constitutional monarchy; it is from this source appointments to office are made, including those constituting the supreme executive. Following this principle, ministers should continue to be appointed by the representative of the Sovereign; public policy, however, would exact that the chief advisers of the Crown should be chosen from and supported by, if not actually nominated by, Parliament. We would thus secure harmonious action and obtain the needed guarantees that "the wishes and interests of the people would on all occasions be faithfully represented and guarded."

The intimate relations between the Executive, Parliament and the people, between the government and the governed, would give to the chief administrative body, the greatest possible stability. It would stand as a central unit to command universal respect. The government so formed would not be greater than Parliament, it would be the executive of Parliament to exercise all the power deputed to Parliament by the people. The executive would be supported by and be amenable to Parliament, and for the reason that Parliament would represent the whole people, the government would rest on the broad basis of the entire nation. Thus we would establish our constitutional structure in a manner and with material so good that it could not be easily shaken. Its foundation would consist of a great electoral body comprising the best of the mass of the community. Its superstructure, a representative body of the best of the whole body

of electors. Its summit, a ministerial body the choice of the representative body, and from the apex of this noble political pyramid would be reflected the lustre of the Imperial Crown itself. What constitutional fabric could be imagined which would give greater unity, greater solidity, and greater dignity?

Many will agree with the writer that it is our duty to face the problem of our political difficulties, and make representative government in practice, what it professes to be in theory—Government of the whole by the whole. He has elsewhere submitted his views and offered suggestions as to the means of overcoming the evils of our present system. He disclaims any pretence to regard the alternative he has submitted as the only or the best solution. In recognizing the gravity of the situation, which indeed is apparent to each of us, he feels that we must, in all earnestness, try to supplement the shortcomings, and eradicate the vices, of politics; with that view he has ventured to offer to the public the opinions he has formed, simply as a humble contribution to the consideration of a vital question in which we are all concerned. One feature of the proposal may require a word of explanation. An electoral system was suggested by which small groups of electors having identical opinions would select deputies by whom and from whom the ultimate representatives would be chosen, the design being to give every elector an equal interest in the election, and through the members elected, an equal voice in Parliament and an equal indirect share in the government. In order peacefully to overcome every obstacle and remove all possibility of friction in special cases the writer suggested falling back on the Apostolic method of settlement by Lot. It is not a new principle of settlement in matters where disputes might otherwise arise; it is sanctioned by the Old and New Testaments, it is employed to-day and has been employed with great advantage for centuries by the Moravians, in selecting fit men for the ministerial office. If employed at all in any electoral system, its use should be restricted to those cases in which no decisive judgment could otherwise be formed, and invariably its use should be exercised with due solemnity, if held expedient, before a court of justice.

The writer has ventured to suggest, as a corollary to the proposed rectification of Parliament, that the executive council should be nominated by the assembled representatives of the people. There are reasons for limiting the term of office of ministers, while at the same time there are important advantages to accrue from a continuity of administration. Both objects might be attained by an arrangement which would necessitate the retirement of a certain proportion of ministers by rotation each

year. They might, however, be eligible for re-appointment. The principle of retirement by rotation may indeed be applied with advantage to Parliament itself. If one-fourth or one-fifth of the representatives retired annually for re-election or to be replaced by others, Parliament would be regularly renewed from year to year, and by this means the Government and Parliament would continually be brought into direct touch with the people, and thus enabled faithfully to interpret the national mind.

Bearing on the proposal to rectify Parliament, it may be confidently affirmed that the present method of electing members does not furnish a correct reflex of the national mind. If the two parties into which the country is politically divided be evenly balanced, and if at a general election one of the parties, by skilful tactics or other means, succeeds in many of the constituencies in gaining the upper hand, however slightly in each case, the opposite party may be almost excluded from representation in the assembly. How misleading, therefore, it is to assume that the majority in Parliament represents the aggregate public opinion of the nation! and yet many are apt to do so until undeceived at the next general election by the movement of the political pendulum to the other side. The consequence of these administrative revolutions is often extremely unfortunate for the country, as each party on accession to power endeavours generally to reverse as much as it can the policy of its predecessor. This condition of unstable equilibrium, inseparable from party government, would, it is believed, be obviated, while continuity of policy, subject only to desirable modifications from time to time, would be secured by the plan suggested.

Election by majorities, it is obvious, is the immediate cause of this instability. Experience everywhere goes to show that elections are often carried by exceedingly narrow majorities, so that a comparative handful of electors, distributed over the constituencies, could, by reversing their votes, transfer the majority in Parliament from one party to the other, and entirely change the character of the administration.

This phase of election by majorities has been examined by Mr. H. R. Droop, in a paper read before the Statistical Society in 1881, in connection with the general elections of the United Kingdom of 1868, 1874, and 1880. Mr. Droop points out that in 1868 it would have been possible by the change of only 1,447 votes to have transferred 66 seats to opposite sides. In 1874, if but 1,269 voters had reversed their votes, 64 seats might have been changed; and in 1880 if 1,929 electors had reversed

their votes 91 seats would have been changed from opposite party sides.* Similar illustrations of the great uncertainty, and the condition of unstable political equilibrium which results from the system of election by majorities are common among ourselves, establishing how disturbing and unsatisfactory the system proves. We should aim to substitute for these constantly recurring violent changes a means of securing continuity of government by a more natural process. By the annual change of a proportion of the members as proposed, we would obtain a settled government, which would mould itself to the varying needs of the people; we would, in fact, substitute government by regular evolution for government by party revolution.

One of the strong arguments advanced by the advocates of party government is that by means of the party organizations an interest is stimulated among the electors in public affairs, and without this stimulant it would be difficult to get voters to go to the polls. If this argument be well founded, the difficulty might be easily overcome through the instrumentality of properly devised machinery which would carry the polls to

* While these pages are passing through the press, a general election has been held in the Province of Quebec, which affords a good illustration of the instability, inseparable from the system of election by majorities. The party until recently in power, under the leadership of Mr. Mercier, had a large majority in the assembly. The general election of March 8th, 1892, resulted as follows :—

Supporters of De Boucherville	54
Supporters of Mercier	17
Independents	2
Total	73

An examination of all the majorities shows that it would have been possible for 804 electors distributed over twenty constituencies, by reversing their votes, to have made the returns as follows :—

Supporters of Mercier	37
Supporters of De Boucherville	34
Independents	2
Total	73

If in 32 constituencies 2,006 electors had changed their votes, the returns would have stood as follows :—

Supporters of Mercier	49
Supporters of De Boucherville	22
Independents	2
Total	73

On such slight contingencies as the change of a few votes under this system the complexion of the government of a Province has been completely revolutionized. *Respice, aspice, prospice.*

the electors. Such a device need not be widely different from the

means employed for effecting assessment purposes, or for taking the census.

Since the views of the writer on this subject have been made public, he has had the advantage of examining other schemes which at different times have been proposed for improving the electoral system. It is recognized by many that the present unsatisfactory system cannot be viewed as permanent, and that it must in the end give place to some better method.

Among the various proposals the electoral scheme of Mr. Thomas Hare, propounded in England in 1857 for the representation of minorities, appears to have met with the greatest favor. The late Right Honorable Henry Fawcett thus speaks of it: "It can hardly be denied that the advantages of this scheme preponderate immensely over its disadvantages, and these last appear insignificant compared with the disadvantages of the present system." In the writings of Mr. Fawcett published in 1873, we find a short explanation of Mr. Hare's scheme of representation. The explanation is a clear and concise exposition of the plan, reduced to its simplest elements, and is referred to in connection with Mr. Hare's treatise, by John Stuart Mill, in the following terms: "The more these works are studied, the stronger, I venture to predict, will be the impression of the perfect feasibility of the scheme, and its transcendent advantages. Such, and so numerous are these, that in my conviction they place Mr. Hare's plan among the very greatest improvements yet made in the theory and practice of government."

It is not a little remarkable that a Danish statesman, Mr. Andrae, should have arrived at the same conclusions as Mr. Hare, by a different process and from an entirely different standpoint. That the scheme is capable of practical application, must be admitted from the fact that its main features have been embraced in the electoral law of Denmark since 1855, for the election of representatives to the Rigsraad. Mr. Andrae's method was likewise applied in 1867 to the law for constituting the Landsthing, and it is still in successful operation.* It will be seen then, that the scheme of minority representation, for which we are indebted to Messrs. Hare and Andrae independently of each other, has had the advantage of an experience of over thirty years. Thus establishing beyond all question, that there is no inherent obstacle in the subject itself, to the securing of an improved system of electoral representation. Mr. Hare's scheme is so important, that a short explanation of it together with other papers on the subject, is appended. This reference to the

* His Excellency Count Sponneck, Danish minister at Washington, writes March 26th, 1892, "the operation of the election law is generally thought to have been very successful."

scheme may be concluded in the author's words: "If by the means proposed, or by any which are better and wiser, an electoral system can be established which in the work of forming a representative body, shall succeed in calling into action all the thought and intellect of the nation, the effect would be to create a new object of enquiry and study, extending over a field of which we know not the bounds. All attempts to engage society in political conflicts for abstract principles would be henceforth vain, and statesmen would seek to build their fame on something more solid and durable than party triumphs."

The great aim and desire of Messrs. Hare, Andrae, Fawcett, Mill, and writers who share their opinions, have been to secure the representation of minorities. Will it be held as a political heresy to say that there should be no minorities to represent? But such is the view of the writer who inclines to the opinion that, outside the walls of Parliament, minorities and majorities should practically be unknown; and moreover that unless the whole electorate, as a body, finds its representation in the national assembly, we do not obtain a true representative Parliament. It is natural that there should be differences of opinion. Such divergences of view are to be expected on every question brought forward for decision, when considered on its merits; and to act with ordinary prudence and wisdom there should be deliberation in public affairs; but deliberation to be of any use must precede decision. It may be asked is the public mind in the heat of a general election in the best state to deliberate on all important legislative questions, or on any question? and can there be any effective deliberation without the electors coming together? Both these queries can only be answered in the negative. It is physically impossible for all the electors to meet in order to deliberate, and in consequence, deliberation can only be effected by deputies or substitutes who assembling in a recognized form will satisfactorily represent the electors, and by their deliberation and decisions will effect substantially the same results as the electors themselves would effect if they had deliberated and voted in one body. Thus it is that Parliament properly constituted becomes the deliberative assembly of the nation, and it is quite obvious, that deliberation and decision on all questions ought to be the function of Parliament alone. This principle being recognised, in Parliament majorities and minorities would be as diversified as the questions discussed. Members in all cases would give their votes according to their own clear, independent convictions, unfettered by pledges or party ties. A stereotyped majority and minority are not possible in a true deliberative body; there would, therefore, be none in the free Parliament we have portrayed. If such a parliament

can be constituted, if it be possible to elect members on some better plan than that now followed, and on sounder principles than that of a numerical majority, the foundation of standing parties would disappear. Neither inside nor outside of Parliament would there be the same causes to develop the growth of the dualism which now exists. There would be an absence of purpose in any effort to inflame the passions or stimulate antagonism in the community. In place of these evils there would be scope and encouragement for the awakening of a calm patriotism, and the nobler instincts of all classes, and under such conditions, it is believed that men of capacity and wisdom, and of good conscience, with minds evenly balanced, would obtain the best chance of being chosen as representatives. A Parliament thus constituted would, as much as it could be possible, be free from a contentious spirit. Its members would be in a fit state to exercise their highest reason in the positions they had been selected to fill.

If the means be put in practice of constituting a Parliament of the whole people, by whatever plan may ultimately be found best, the great and permanent cause of political conflict would be removed, inasmuch as no interest would be excluded from the legislative body, and no individual elector would be deprived of his fair share in the general government through Parliament, in which he would be represented. Thus it would result that party organizations would lose support, their lines of cleavage would be obliterated, and the party divisions which now form a dualism in the State would disappear and practically become blended into one. No doubt occasions would from time to time arise, when members in Parliament would differ in opinion on important questions, and those of the same way of thinking would co-operate in order to carry their views to a successful issue. Under such circumstances it might, with truth, be said that the combinations formed would be of the nature of parties, but they would be merely special and temporary associations, to cease in each case as the questions would be disposed of. There would no longer be the same cause to induce the organization of permanent parties with their members arrayed as foemen one side against the other —voting on all questions identically. There would be no *raison d'être* for two such antagonistic forces, as now exist, with fixed antipathies, disputing under party banners every inch of ground, and mutually wasting their energies in ceasless conflict.

It will be generally admitted among thoughtful men that one of the most pressing needs of the Canadian people at this moment is the satisfactory solution of the problem set forth ; and the purpose of these brief

remarks will have been attained if it be shown that a way may be opened by which the flames of political discord may be extinguished, and the *virus* of evil which taints our body politic be neutralized.

A Parliament, fairly representing the whole people, would realize the idea of a true deliberative and legislative unit. Devotion to country would be substituted for devotion to party, and the tendency would be, not to exhaust and neutralize the mental forces of the people's representatives in fruitless agitation and barren debates, but to bring the united energies of the wisest and ablest statesmen on both sides to act with purposes in common. They would no longer appear as political enemies to lead on the rank and file in successive faction fights, and interminable struggles; if ever contentions arose it would be in generous efforts to determine who could accomplish the greatest public good.

As already pointed out, we have happily in this new land no social complications or traditional impediments to encumber our political constitution, or clog the working of any improvement in our system of government. In Canada we are in a state of general and continuous development. Year by year we advance forward as our fathers did before us. If the methods of our fathers do not serve the purposes of the present generation, we must, as they would have done, abandon the methods of our fathers. When we find defects in our political condition, it is our duty to discover their origin and remove causes of friction by a re-adjustment of the legislative machinery. Now that the foundations of the Dominion are laid broad and deep, we should, by every means in our power, endeavour to prevent and obliterate divisions which tend to cleave us in two. We should have one aim, one aspiration in our political partnership. We should seek to remove the causes which have led to divergence in the past and be animated with one desire, the welfare of Canada as a whole: one determination, to promote her prosperity and maintain her honour.

If imbued with these sentiments, the sons of Canada approach the consideration of the subject which the writer has humbly endeavored to present—who can doubt that we shall witness the dawning of a new day in public life in this fair land of ours? Let us with confidence entertain the conviction, that before long there will be a new departure in politics; that for divisions and weakness and instability, with a long train of evils, there will be the unity, and strength, and security, which proceed from wisdom, and peace, and concord.

NOTES ON THE DISCOVERER OF THE GREAT FALLS OF LABRADOR.*

By David Boyle, Ph.B.

(Read 17th December, 1891.)

The peninsula of Labrador measured from the Straits of Belle Isle to Cape Wolstenholme is 1,100 miles; its greatest breadth is 700 miles, and its area is computed at 420,000 square miles, being equal to that of the British Islands, of France and of Prussia combined. A table-land 2,240 feet above sea-level occupies the interior. Hind says "it is pre-eminently sterile, and where the country is not burned, caribou moss covers the rocks; with stunted spruce, birch and aspen in the hollows and deep ravines. The whole of the table-land is strewed with an infinite number of boulders, sometimes three and four deep; these singular erratics are perched on the summit of every mountain and hill, often on the edge of cliffs, and they vary in size from one foot to twenty feet in diameter. Language fails to paint the awful desolation of the table-land of Labrador."

Even at the present day, so unattractive is this territory that there is in the whole world no other area of even one-half the extent, regarding which so little is known. Winter begins in September and lasts until June, on the northern slope.

Here the Hudson Bay Company, lured by prospective profits in the fur-trade, established a post in 1831. The site chosen was about thirty miles from the mouth of the Koksoak or Caniapuscaw River, also known as the South River, which, flowing northwards enters the head of Ungava Bay, an expansion of Hudson's Straits. Owing to the total absence of beavers, the scarcity of other valuable fur-bearing animals, and the difficulty connected with supplying the post with provisions, the project, of which the prime mover was Mr. (afterwards Sir George) Simpson, proved a failure. But he "determined on making every effort to reduce the expense, and if possible, to increase the returns," chiefly, it would appear, for the purpose of maintaining his reputation with the company, the members of which were dissatisfied with the results.

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* Based on the manuscript journal of Mr. John McLean, now in the possession of his son Mr. Archibald McLean, Buffalo.

To this inhospitable region, and under these untoward circumstances, Mr. John McLean was ordered in the winter of 1837.

This gentleman was born on the banks of Lochba, within the shadow of grim old Benmore, in Argyleshire, about the end of 1797, or the beginning of 1798. He entered the service of the Hudson Bay Company in the winter of 1820-21, being, consequently about twenty-two years of age at that time. He arrived in Montreal in January, 1821, and after spending three or four months in residence with "the parish priest of Petit le Maska,* for the purpose of studying the French language," he was ordered to the post of Lake of Two Mountains. Here, he states that the village "is inhabited by two distinct tribes of the aborigines,—viz.: the Iroquois and the Algonquins; the latter are a tribe of the Sauteaux nation, or Ojibbeway, and live principally by the chase, the former cultivate the soil and engage as voyageurs, or in any other capacity that may yield them the means of subsistence." His next post was at the Chats, further up the Ottawa, and in June of 1822, he was appointed to Fort Coulonge, eighty miles higher up the river.

On the conclusion of his three years' apprenticeship he was placed in "charge of Lac de Sable, a post situated on a tributary of the Ottawa, called *Riviere aux Lièvres*, two hundred miles distant from Montreal." Here he remained several years and succeeded by his admirable management in driving away all the company's trade rivals, and placing the affairs of the post in a good business condition. On this account he complains bitterly that he was removed to a more distant situation. He says, "I had now served the Hudson's Bay Company faithfully and zealously for a period of twelve years, leading a life of hardship and toil, of which no idea can be formed except by those whose hard lot it may be to know it by experience. . . . And what was my reward? I had no sooner succeeded in freeing my district from opposition, than I was ordered to resign my situation to another who would enjoy the results of my labour."

Poor fellow, he little knew how much more hardship and ill-treatment were yet in store for him!

Being now ordered to the North West, he describes his tedious journey from Montreal up the Ottawa, travelling much by canoe, through Lake Nipissing and French River, mentioning Fort Mississaga, Sault Ste. Marie, Fort William, Lac la Pluie and River, Lake Winnipeg and Norway House. At the last named post he met Captain Back the Arctic traveller After spending a short time here, he was notified to proceed to New Caledonia, via Athabasca and Fort Dunvegan.

* Yamaska?

At Cumberland House, on his way to his new post he says, "I was cheered by the sight of extensive corn-fields, horned cattle, pigs and poultry, which gave the place more the appearance of a farm in the civilized world, than of a trading post in the North West; and I could not help envying the happy lot of its tenant, and contrasting it with my own, which led me to the wilds of New Caledonia—to fare like a dog, without knowing how long my exile might be protracted."

On the 28th of October, 1833, he arrived at Fort St. James near the outlet of Stuart's Lake, the present abiding place of the Canadian Institute's learned member and correspondent, Rev. A. G. Morice, O. M. I.

He describes the lake and its neighborhood in glowing terms, and concludes in these words:—"I do not know that I have seen anything to compare with this charming prospect in any other part of the country; its beauties struck me even at this season of the year, when nature having partly assumed her hybernal dress, everything appeared to so much greater disadvantage."

His next appointment was to Fort Alexandria which he refers to as a "post agreeably situated on the banks of the Fraser River, on the outskirts of the great prairies. . . . The charming locality, the friendly disposition of the natives, and better fare, rendered this post one of the most agreeable situations in the Indian country." Here, however, he remained only from March till the end of May, when he was ordered back to Stuart's Lake. The following September he was appointed to take charge of Fort St. George, where the servants of a former chief trader had all been murdered by the Indians only a few years before. But he says "a great change has come over this people since that time; they are now justly considered the best disposed and most industrious Indians in the district."

Having applied to the governor for permission to visit head-quarters, he left Stuart's Lake on the 22nd of February, 1837, reached Fort Alexandria on the 8th of March, Kamloops on the 18th, Onkonagan on the left bank of the Columbia River on the 28th, and on the 12th of April arrived at Colville. Here there is a great gap in his account of this trip, but we learn that he succeeded in getting to York Factory early in July. Of this post he says: "It presented a more respectable appearance than any that I have seen in Rupert's Land, and reflects no small credit on the talents and taste of him who planned, and partly executed the existing improvements." He afterwards gives a long and interesting account of the physical features, natural history, and native population of the country around the factory. Still, York Factory was not to Mr.

McLean one of those places, "where every prospect pleases," for he says: "Every preparation for our departure being now completed, I took leave of Fort York, its fogs, and bogs and mosquitoes, with little regret." He embarked in a brig on the 22nd of August, he does not say for what point, but we afterwards learn his destination to have been Fort Chimo, near the mouth of the Ungava or Caniapuscaw River. On this voyage he narrowly escaped the loss of his life more than once. Of Fort Chimo he writes, "I was much gratified by the appearance of everything about the establishment. The buildings had just been finished with materials sent out from England, through the considerate and kindly feeling of the committee, whose compassion had been excited by the accounts they had heard of the miserable hovels in which the people were lodged when the place was first settled." It is at this point in his journal that he makes the first reference to his wife, of whom I have heard it stated, that she was a very beautiful and intelligent native of one of the western tribes. Referring to the departure of the vessel he says, "The clank of the capstan while the operation of weighing was being executed, echoing from the surrounding hills, suggested the question, 'When shall that sound be heard again?' From the melancholy reverie which this idea suggested, I was roused by the voice of my fellow exile, 'the companion of my joys and sorrows,' in whose society such gloomy thoughts could not long dwell."

With such a scene as was spread out before them, he might well be pardoned for entertaining gloomy forebodings, for "This post," he says, "is situated in lat. 59° 28′ standing on the east bank of South River, about thirty miles distant from the sea, surrounded by a country that presents as complete a picture of desolation as can be imagined; moss-covered rocks without vegetation and without verdure, constitute the cheerless landscape that greets the eye in every direction. A few stunted pines growing in the villages form the only exception and at this season of the year, when they shed their leaves,* contribute but little to the improvement of the scene."

I have already referred to circumstances connected with the establishment of Fort Chimo, but the following from Mr. McLean's own pen enables us to understand how it came about that he made the discovery of the Great Falls. He says, "I was directed to push outposts into the interior, to support my people on the resources of the country, and at the same time to open a communication with Esquimaux Bay, on the coast of Labrador, with the view of obtaining in future my supplies from thence by inland route; there being no question of the practicability of

* Probably this refers to the hackmatac or tamarac.

the rivers. So said not he who had seen those rivers. Mr. Erlandson had traversed the country in the spring of 1834, and represented to me the utter impossibility of carrying my instructions into effect."

Having determined without loss of time to visit Esquimaux Bay, fully six hundred miles to the south east, he set out on the 2nd day of January, 1838, accompanied by Donald Henderson, Henry Hay, and two Indian guides: Pierre Neven and M. Ferguson went part of the way, "each driving a sled of two dogs, loaded with provisions, the other men having sleds drawn by themselves."

He arrived at Fort Smith, on Esqimaux Bay on the 16th of Feb., the journey having lasted forty-five days, the rate of travel varying from one mile to twenty miles a day. On the return to Ungava the whole party suffered dreadfully. The Indians took influenza of a very severe type—the guide becoming for a time delirious—provisions ran short—game was not to be had, and we read, "One of our dogs being starved to death, we were ultimately obliged to knock the surviving one on the head to supply ourselves with what we considered, in our present circumstances, 'food for the gods.'"

This journey proved the impracticability of inland water communication by any known route, but "having learned from the natives that a river fell into the bay, about eighty miles to the eastward, that offered greater facilities for carrying on the business in the interior than our present communication, I ordered the men who had assisted Mr. Erlandson to descend by this river,—an enterprise which was successfully accomplished."

"At this time," he writes, "I was visited by a very grievous affliction, in the loss of my beloved wife, whose untimely death left me in a more wretched condition than words can express. This [1838] was truly an eventful year for me; within that space I became a husband, a father*, and a widower. I traversed the Continent of America, performing a voyage of some 1,500 miles by sea, and a journey by land of fully 1,200 miles on snow-shoes." In this year too, he records that in September he was "gratified by the arrival of dispatches from Canada, brought by a newly appointed junior clerk, who also gave the 'first intelligence of the stirring events that had taken place in the colonies during the preceding year.'"

Again he writes, "The favorable report of last summer respecting the

* John McLean, junior, the son born in Ungava, was an intimate acquaintance of my own twenty-eight years ago. He was a bright intelligent young fellow, but for a long time I have heard nothing of him.

East, or George's River, combined with reports that had reached me since, of another large river flowing a short distance to the south of Esquimaux Bay, suggested the possibility of carrying on our business on this line of communication." He therefore had a boat built during the winter, and on the 25th of June, 1839, as soon as the river was clear of ice, he set out on his second journey, to discover, if possible, a river route between the inhospitable Ungava and the southern coast.

He reached the mouth of George's River on the 2nd of July. His crew consisted of "ten able men" and "an Indian guide in his canoe." Unusually low water rendered the ascent of the George's River a slow and difficult undertaking, wading, towing, pulling, carrying and launching the boat many times daily was "no easy matter," especially as he says, "when myriads of sand-flies and mosquitoes filled the air and tortured us incessantly." At length on the 15th of August, they reached the interior post established by Mr. Erlandson, "half starved, half naked, and half devoured." This appears to have brought the party to the southern slope of the height of land, although no mention is made of that fact, but what follows is evidence enough to this effect, and here I quote in full what he says regarding the discovery of the Great Falls.

"After one day's rest, we embarked in a canoe sufficiently large to contain several conveniences, to which I had been for some time a stranger, a tent to shelter us by night, and tea to cheer us by day; we fared, too, like princes, on the product of 'sea and land' procured by the net and gun. We thus proceeded gaily on our downward course without meeting any interruption, or experiencing any difficulty in finding our way; when, one evening, the roar of a mighty cataract burst upon our ears, warning us that danger was at hand. We soon reached the spot, which presented to us one of the grandest spectacles in the world, but put an end to all hopes of success in our enterprise.

"About six miles above the fall the river suddenly contracts from a width of from four hundred to six hundred yards, to about one hundred yards; then rushing along in a continuous foaming rapid, finally contracts to a breath of about fifty yards ere it precipitates itself over the rock which forms the fall; when, still roaring and foaming, it continues its maddened course for about a distance of thirty miles, pent up between walls of rock that rise sometimes to the height of three hundred feet on either side. This stupendous fall exceeds in height the Falls of Niagara, but bears no comparison to that sublime object in any other respect, being nearly hidden from view by the abrupt angle which the rocks form immediately beneath. If not seen, however, it is felt; such is the extraordinary force with which it tumbles into the abyss underneath, that we

felt the solid rock shake under our feet, as we stood two hundred feet above the gulf. A dense cloud of vapour, which can be seen at a great distance in clear weather, hangs over the spot. From the fall to the foot of the rapid—a distance of thirty miles—the zigzag course of the river presents such sharp angles, that you see nothing of it until within a few yards of its banks. Might not this circumstance lead the geologist to the conclusion that the fall had receded this distance? The mind shrinks from the contemplation of a subject that carries it back to a period of time so very remote; for if the rock, syenite, always possessed its present solidity and hardness, the action of the water alone might require millions of years to produce such a result."

This is the passage that unmistakeably stamps John McLean as the discoverer of the Great Falls, to which but for his modesty he would have given a name, and regarding which, but for the same reason, he would never afterwards have permitted the world to forget his claim as discoverer. Unlike the first white man who looked upon the Falls of Niagara, he did not even attempt to exaggerate the height—he simply states that they "exceed in height" the world-renowned Canadian fall,and recent observations have shown they are nearly twice as high as the great Niagara leap.

Brief too, as is his reference to this notable discovery, his language bears proof of the fact that he was a man of more than ordinary observation and intelligence, considering the state of science upwards of half a century ago, for not only does he note the syenitic quality of the rock, but muses on the vast period of time that must have elapsed for the water to wear its way slowly thirty miles back from the foot of the rapids, cutting through material of such solidity and hardness. In the few sentences that follow, I shall briefly sketch the remainder of his life.

Although Mr. McLean recommended the abandonment of the Ungava settlement, he was left in charge of it until 1842, having meanwhile, made three more journeys to Esquimaux Bay, hoping against hope to find a practicable land and river route. When he arrived there on his last voyage, he was gratified to receive intelligence that the directors, in accordance with his recommendation had determined to abandon Ungava, a "ship being ordered round this season to convey the people and property to Esquimaux Bay."

Not the least remarkable among the many events of McLean's quarter of a century in the Company's service, is the passage he made to Britain after being relieved of duty at Fort Chimo.

I have heard the story more than once from his own lips. "On the 18th August, 1842," he "embarked on board a small schooner of sixty

tons, deeply laden with fish and oil," and made the passage across the Atlantic, from York Factory in a fortnight! One would hardly like to venture across Lake Ontario in such a tiny craft, with such a cargo, and so much of it, but, as he declares "the inconveniences weighed lightly in the scales, when compared with the anticipated delight of visiting one's native land."

Reaching his Highland home on 20th of September, he says, "the meeting of a mother with an only son after so long an absence (twenty-three years) need not be described, nor the feelings, the well-known scenes of youthful sports and youthful joys gave rise to."

About the middle of January, 1843, he found himself in New York on his way back to the service of the Company, and in proof of his critical faculty and the extent of his reading I quote the following paragraph.

"As to the peculiar phrases the Americans use in conversation, I am convinced that their forefathers brought the greater part of them from Britain, as many of those phrases are to be found in the works of old English authors still extant. The English language as spoken in America is elegance itself, compared to the provincial dialects of Britain, or even to the vile slang one hears in the streets of London. This is a fact that every one who has travelled in America must admit."

Elsewhere, he writes of the United States and her citizens in a highly complimentary way, in a way indeed quite unusual among British authors of that period, and for a long time subsequently.

On his return to Montreal he was ordered to York Factory, where he received an appointment on the Mackenzie River, very much to his disgust. For many years he and Governor Sir George Simpson had not pulled well together, and the correspondence shows that Simpson was actuated by base motives in his treatment of McLean.

The last post he held was at Great Slave Lake, when he severed his connection with the service in 1845. After this he married a daughter of the Rev. Mr. Evans, a Methodist missionary in the North-West, and inventor of the Cree phonetic character, in which the books in that language are printed. His family as I knew it, consisted of one son, and three beautiful daughters, all of whom are still living.

I am unable to state what his movements were immediately after his resignation, but in course of time he made his way to Guelph, then a young and flourishing town. Here he remained for some years, and here he certainly was in 1849, as we learn from the preface to his first volume.

In personal appearance John McLean was above the average height, wiry and well-knit, rather than stout. He had marked features, and as a young man, was no doubt handsome. During my acquaintance of many years with him, he did not appear to "age" very much. His complexion was unusually pale and clear, and his deeply furrowed face was always clean shaven. His step was firm, and his carriage as erect at the age of eighty-five, as if he had served in the army.

In manner he was reserved, but could, and did, show a genial side in the company of a few. To strangers he appeared to be haughty and dignified, but this was only the visible Celt, for beneath that exterior he was as humble, as modest, and as tender-hearted as a child. He had a warm side to the Indians among whom he spent so many years. He understood their character thoroughly, and sympathised with their lot. When it was the custom of bands from Saugeen, and other points to visit what was the "front," from twenty-five to thirty years ago, for the purpose of selling baskets and bead-work, they invariably called to have a talk with Mr. McLean, who was then, and for long afterwards a resident of Elora.

As a scholar he was accomplished. His acquaintance with the classics was more than superficial, he was well read in French and English, and was, as a matter of course, quite familiar with Gaelic. Besides all this, he had a pretty thorough knowledge of the principal Indian languages, as spoken from one side of the continent to the other.

During the many years I knew him, he was clerk of the Division Court in the district of which Elora is the centre, but some years since he went to reside with his youngest daughter in Victoria, British Columbia, where he died on the 5th of March, 1890, in his 92nd year.

Not least among the services he rendered during his life time in Canada, should be reckoned the active part he took in awakening public attention to the expiry of the Hudson Bay Company's charter, and in pointing out the real value of what is now our great North West, as a field for colonization.

He held advanced political views, but was not an active politician, and this, no doubt is the reason why he was not regarded as having any "claims" for consideration where preferment and emolument were concerned.

Before us are two manuscript volumes written by Mr. McLean, the contents of which cover the long period of his service in the Hudson Bay Company. For the privilege of having been permitted to examine these, and to exhibit them here this evening, I am indebted to Mr.

Archibald McLean, the younger son of the old trader and traveller whose career I have briefly outlined.

In substance these are almost identical with the printed volumes entitled "Twenty-five Years' Service in the Hudson Bay Territory."

I have written these notes on the discoverer of the Great Falls of Labrador, both as a personal tribute of respect to an old friend, and as a public duty in memory of one who spent a quarter of a century in Canada, before many of us were born—whose treatment of the natives was invariably humane—whose intimate knowledge of the interior stood us in good stead at a time when it was most required,—whose services to his employers may be regarded as of national importance—who first made known to us the existence of one of the world's highest cataracts —who, as an author, has given us two of the most interesting and instructive books of travel and adventure in North America—who is said to figure as one of the characters in Ballantyne's "Ungava," and who after more than seventy years' residence in this country, passed away to "where the weary are at rest," having lived not only a long, but an active and a useful life.

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L'Institut Canadien de Québec..... "
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(2.)—UNITED STATES.

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Anthropological Society of Washington ..... "
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American Monthly Microscopical Journal ..... "
California Academy of Science ..... San Francisco, Cal.
Technical Society of the Pacific Coast ..... "
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University of California ..... Berkeley, Cal.
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American Journal of Science ..... New Haven, Conn.
Connecticut Academy of Arts and Sciences ..... "
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American Antiquarian and Oriental Journal ..... "
Illinois State Laboratory of Natural History ..... Champaign, Ill.
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Academy of Natural Sciences.....Minneapolis.
Geological and Natural History Survey of Minnesota..... "
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Academy of Sciences.....St. Louis, Mo.
Missouri Historical Society..... "
The Library, Missouri Botanical Gardens..... "
Nebraska State Historical Society.....Lincoln, Neb.
"University Studies," University of Nebraska..... "
New Jersey Historical Society.....Newark, N.J.
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Journal of Speculative Philosophy..... "
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Linnean Society of New York..... "
New York Microscopical Society..... "
School of Mines Quarterly, Columbia College..... "
American Geographical Society..... "
New York Academy of Anthropology..... "
American Chemical Society..... "
Electrical Review..... "
Electrical Engineer..... "
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Political Science Quarterly..... "
"Christian Thought"..... "
New York State Library.....Albany, N.Y.
New York State Museum of Natural History..... "
Buffalo Society of Natural Sciences.....Buffalo, N.Y.
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Elisha Mitchell Scientific Society.....University of North Carolina.
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Journal of Comparative Neurology..... "
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Library Department, Commonwealth of Pennsylvania.....Harrisburg.
University of Pennsylvania.....Philadelphia.
American Catholic Quarterly Review..... "

"American Notes and Queries" ..... Philadelphia.
American Naturalist ..... "
American Philosophical Society ..... "
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Institute of Jamaica ..... Kingston, Jamaica.
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(1.)—GREAT BRITAIN AND IRELAND.

ENGLAND.

Birmingham Natural History and Microscopical Society ..... Birmingham.
Journal of Microscopy and Natural Science ..... Bath.
Bristol Naturalists' Society ..... Bristol.

Cumberland and Westmorland Association for the Advancement of Literature and Science ..... Carlisle.
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Revue de Linguistique et de Philologie Comparée ..... "
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Société Mathématique de France..... "

Feuille des Jeunes Naturalistes.....Paris.
Tablettes Coloniales..... "
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Bulletin d'Histoire Ecclésiastique et d'Archéologie Religieuse des Diocèses de Valence, Gap, Grenoble, et Viviers.....Romans. —40.

(6.)—GERMANY.

Naturforschende Gesellschaft zu Freiburg.....Baden.
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Gesellschaft für Erdkunde..... "
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Germanisches Nationalmuseum ..... Nürnberg.
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Zeitschrift für Physiologische Chemie ..... Strassburg.
Kaiserliche Universitäts- und Landes-Bibliothek ..... "
Verein für Vaterländische Naturkunde in Würtemberg ..... Stuttgart.
Nassauischer Verein für Naturkunde ..... Wiesbaden. —53.

(7.)—ICELAND.

Islenzka Fornleifafélags ..... Reykjavik. —1.

(8.)—ITALY.

Società Italiana dei Microscopisti ..... Acireale.
R. Accademia Petrarca di Scienze, Lettere ed Arti ..... Arezzo.
R. Accademia delle Scienze dell' Istituto di ..... Bologna.
Ateneo di Brescia ..... Brescia.
Società Storica per la Provincia e Antica Diocesi di Como ..... Como.
R. Istituto di Studi Superiori in Firenze ..... Firenze.
Società Italiana di Antropologia, Etnologia, e Psicologia comparata .... "
Sezione Fiorentina della Società Africana d'Italia ..... "
Società Entomologica Italiana ..... "
Società di Lettura e Conversazione Scientifiche ..... Genova.
Società Ligustica di Scienze Naturali e Geografiche ..... "
Società Ligure di Storia Patria ..... "
R. Accademia Lucchese di Scienze, Lettere ed Arti ..... Lucca.
R. Accademia di Belle Arti ..... Milano.
R. Istituto Lombardo di Scienze e Lettere ..... "
Società Italiana di Scienze Naturali ..... "
Società Veneto-Trentina di Scienze Naturali ..... Padova.
Nuova Notarisia ..... "
Società Toscana di Scienze Naturali ..... Pisa.
Gazzeta Chimica Italiana ..... Palermo.
Circolo Matematico di Palermo ..... "
Società Siciliana per la Storia Patria ..... "
R. Accademia di Scienze, Lettere, e Belle Arti di Palermo ..... "
Direzione del Giornale del Genio Civile ..... Roma.
Società Geografica Italiana ..... "
R. Comitato Geologico d'Italia ..... "
R. Accademia dei Lincei ..... "
Accademia Pontificia de' Nuovi Lincei ..... "
Bullettino di Bibliografia e di Storia delle Scienze Matematichee Fisiche. "
Specula Vaticana ..... "
Rassegna delle Scienze Geologiche in Italia ..... "
"Cosmos" di Guido Cora ..... Torino.
Archivio di Letteratura Biblica ed Orientale ..... "
R. Accademia delle Scienze ..... "
Notarisia, Commentarium Phycologicum ..... Venezia.
R. Istituto Veneto di Scienze, Lettere ed Arti ..... " —36

(9.)—NETHERLANDS.

Koninklijke Akademie van Wetenschappen ..... Amsterdam.
Kon. Zoologisch Genootschap "Natura Artis Magistra" ..... "
Kon. Nederlandsch Aardrijkskundig Genootschap ..... "

École Polytechnique de Delft ..... Delft.
Koninklijk Instituut voor de Taal-, Land- en Volkenkunde van Nederlandsch-Indië ..... 'S Gravenhage.
Société Hollandaise des Sciences ..... Harlem.
Fondation de P. Teyler van der Hulst ..... "
Nederlandsche Botanische Vereeniging ..... Leiden.
Nederlandsche Dierkundige Vereeniging ..... "
Recueil des Travaux Chimiques des Pays-Bas ..... "
Koninklijk Nederlandsch Meteorologisch Instituut ..... Utrecht. —11.

(10.)—NORWAY.

Musée de Bergen ..... Bergen.
Polytekniske Forening ..... Kristiania.
Forening til Norske Fortidsmindersmerkers Bevaring ..... "
Videnskabs Selskabet ..... "
Kongelige Norske Frederiks Universitet ..... "
Nyt Magazin for Naturvidenskabernes ..... "
Norwegische Commission der Europæischen Gradmessung ..... "
Tromsö Museum ..... Tromsö.
Kon. Norske Videnskabernes Selskab ..... Trondhjem. —9.

(11.)—PORTUGAL.

Sociedade de Geographia de Lisboa ..... Lisboa.
Académie Royale des Sciences de Lisbonne ..... " —2.

(12.)—ROUMANIA.

Institut Météorologique de Roumanie ..... Bucarest —1.

(13.)—RUSSIA.

Société des Naturalistes à l'Université Impériale de ..... Kharkow.
Société des Naturalistes à l'Université de St. Wladimir ..... Kiew.
Societas Scientiarum Fennica ..... Helsingfors.
Société de Géographie de Finlande ..... "
Tifliser Observatorium ..... Tiflis.
La Section Caucasienne de la Société Impériale Russe de Géographie .... "
Société Impériale des Naturalistes de Moscou ..... Moscou.
Société Physico-chimique Russe à l'Université de ..... S. Pétersbourg.
Comité Géologique ..... "
La Société Impériale Russe de Géographie ..... "
La Section de la Sibérie orientale de la Société Impériale Russe de Géographie ..... Irkutsk. —11.

(14.)—SPAIN.

"Crónica Cientifica" ..... Barcelona.
"Revista Tecnologico Industrial" ..... "
Real Academia de Ciencias Naturales y Artes ..... "
Real Academia de Ciencias Morales y Politicas ..... Madrid.
Real Academia de la Historia ..... "
Sociedad Geográfica de Madrid ..... " —6.

(15.)—SWEDEN.

Kongliga Universitetet ..... Lund.
Kongliga Fysiografiska Sällskapet ..... "

Kongliga Svenska Vetenskaps-Akademien ....Stockholm.
Kongliga Bibliotheket .... " "
Stockholms Högskola ..... " "
Svenska Sällskapet för Antropologi och Geografi ..... " "
Geologiska Förening i Stockholm .... " "
"Acta Mathematica" .... " "
Kongliga Universitetet .... Upsala. —9

(16.)—SWITZERLAND

Geografische Gesellschaft von Bern ..... Bern.
Naturforschende Gesellschaft in Bern .... " "
Société de Physique et d'Histoire Naturelle ..... Genève.
Société de Géographie de Genève .... " "
Institut National Génevois ..... " "
Société Vaudoise des Sciences Naturelles ..... Lausanne.
Société Neuchâteloise de Géographie .... Neuchâtel.
Naturforschende Gesellschaft in Zürich ..... Zürich. —8

(17.)—TURKEY.

Syllogue Littéraire Grec de ..... Constantinople. —1

III.—ASIA.

(1.)—INDIA.

Asiatic Society of Bengal .... Calcutta.
Geological Survey of India ..... " "
Editor of the "Record" .... " "
Survey of India Department .... " "
"Indian Antiquary" .... Bombay.
Government Central Museum and Library ..... Madras.
"Orientalist" .... Kandy, Ceylon —7

(2.)—STRAITS SETTLEMENTS.

Journal of the Straits Branch of the Royal Asiatic Society ..... Singapore. —1

(3.)—JAPAN.

University of Tōkyō .... Tōkyō.
Asiatic Society of Japan ..... " "
Deutsche Gesellschaft für Natur- und Völkerkunde Ostasiens ..... " "
Literature College of Imperial University of Japan .... " "
College of Science, Imperial University of Japan ..... " "
Tōkyō Anthropological Society ..... " —6

(4.)—JAVA.

Bataviaasch Genootschap van Kunsten en Wetenschappen ..... Batavia.
Nederlandsch-Indische Maatschappij van Nijverheid en Landbouw ..... " —2

(5.)—CHINA.

China Branch of the Royal Asiatic Society ..... Shanghai.
Observatory of Hong Kong, and Government Publications ..... Hong Kong.
His Excellency the Governor of Hong Kong .... " —3.

(6.)—COCHIN-CHINA.

Société des Études Indo-Chinoises.....Saigon. —1.

IV.—AFRICA.

(1.)—ALGERIA.

Société Archéologique du Départment de Constantine .....Constantine.
Société de Géographie et d'Archéologie de la Province d'Oran .....Oran.
Académie d'Hippone .....Bône. —3.

(2.)—CAPE COLONY.

South African Philosophical Society.....Cape Town. —1.

(3.)—EGYPT.

Institut Égyptien.....Cairo. —1.

V.—AUSTRALASIA.

(1.)—AUSTRALIA.

Royal Society of New South Wales.....Sydney.
Royal Geographical Society of Australasia ..... "
Department of Mines, New South Wales ..... "
Linnean Society of New South Wales. ..... "
Board of Technical Education ..... "
Australasian Association for the Advancement of Science..... "
Royal Society of South Australia .....Adelaide.
Royal Society of Queensland.....Brisbane.
Queensland Museum ..... "
Royal Society of Victoria .....Melbourne.
Public Library of Victoria..... "
Hon. Premier of Victoria ..... " —12.

(2.)—NEW ZEALAND.

New Zealand Institute .....Wellington. —1.

(3.)—TASMANIA.

Royal Society of Tasmania .....Hobarton. —1.

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